ARCTIC INDUSTRIAL ACTIVITIES COMPILATION – VOLUME 3

Canadian Beaufort Sea: Seismic and Sounding Surveys, Vessel Movements, Helicopter Traffic and Site-Specific Activities

1980 to 1986

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Canadian Data Report Of Hydrography and Ocean Sciences

These reports provide a medium for the documentation and dissemination of data in a form directly useable by the scientific and engineering communities.

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Rapport statistique canadien sur l'hydrographie et les sciences océaniques

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En général, les rapports contiennent des données brutes ou analysées mais ne fournissent pas d'interprétations des données. Ces compilations sont préparées le plus souvent à l'appui de travaux reliés aux programmes et intérêts du service des Sciences et Levés océaniques (SLO) du ministère des Pêches et des Océans.

Les rapports statistiques sont produits à l'échelon régional mais sont numérotés et placés dans l'index à l'échelon national. Les demandes de rapports seront satisfaites par l'établissement auteur dont le nom figure sur la couverture et la page de titre. Les rapports épuisés seront fournis contre rétribution par des agents commerciaux.

Les établissements des Sciences et Levés océaniques dans les régions et à l'administration centrale ont cessé de publier leurs diverses séries de rapports depuis décembre 1981. Vous trouverez dans l'index des publications du volume 38 du *Journal canadien des sciences halieutiques et aquatiques*, la liste de ces publications ainsi que le dernier numéro paru dans chaque catégorie. La nouvelle série a commencé avec la publication du Rapport n° 1 en janvier 1982.

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VOLUME 3

CANADIAN BEAUFORT SEA: SEISMIC AND SOUNDING SURVEYS, VESSEL MOVEMENTS, HELICOPTER TRAFFIC, AND SITE-SPECIFIC ACTIVITIES 1980 TO 1986

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SERIES ABSTRACT

Brouwer, P., J.W. McDonald, W.J. Richardson and R.A. Davis, 1988. Arctic Industrial Activities Compilation: Volume 3; Canadian Beaufort Sea: Seismic and Sounding Surveys, Vessel Movements, Helicopter Traffic, and Site-Specific Activities 1980 to 1986. Can. Data Rep. Hydrogr. Ocean Sci. 32: (Vol. 3) 170p.

This volume is one of a group of catalogues designed to compile and summarize important descriptive details of selected industrial activities carried out in the offshore Canadian Arctic during the past two or three decades. For user convenience, the Arctic has been arbitrarily divided into seven geographical areas, incorporating where possible, major oceanographic regions. These seven areas coincide with those of a companion series, namely, the Arctic Data Compilation and Appraisal catalogues which describe historic oceanographic data (currents, hydrocarbons, whales, -- to mention a few). The approach and format within and between these catalogues and series are intended to facilitate comparison among subjects and regions.

With such a large undertaking, it is not possible to provide all catalogues at once. Therefore, publications which are presently available in the series are indicated on the inside back cover of each volume.

Marine industrial development is ongoing, and further updates of these catalogue descriptions are planned. Readers are requested to submit corrections and additions by writing to the issuing establishment. Such revision will be incorporated into an interactive computer graphics and listing system, and custom reports and maps will be available upon request.

Key words: Canadian Arctic, marine industrial activities, catalogue, database.

RESUME

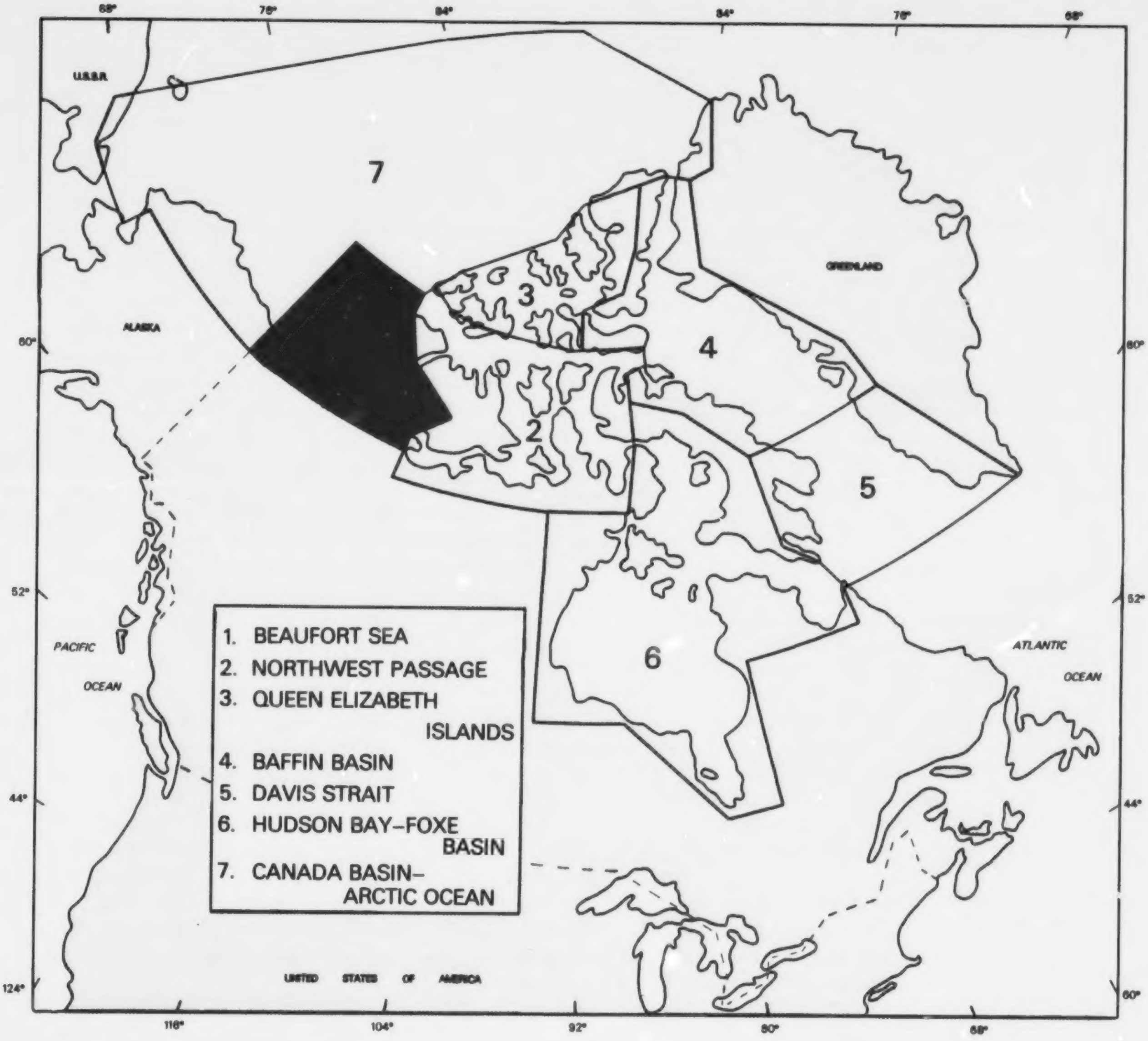
Brouwer, P., J.W. McDonald, W.J. Richardson and R.A. Davis, 1988. Arctic Industrial Activities Compilation: Volume 3; Canadian Beaufort Sea: Seismic and Sounding Surveys, Vessel Movements, Helicopter Traffic, and Site-Specific Activities 1980 to 1986. Can. Data Rep. Hydrogr. Ocean Sci. 32: (Vol. 3) 170p.

Le présent volume fait partie d'une série de répertoires conçus pour la compilation et le resumé des importants détails descriptifs d'activités industrielles choisies effectuées dans les eaux hauturières canadiennes de l'Arctique au cours des deux ou trois dernières décennies. Pour faciliter l'utilisation de l'ouvrage, les auteurs ont divisé arbitrairement l'Arctique en sept zones géographiques incorporant, si possible, de grandes régions océanographiques. Ces sept zones coincident avec celles d'une série associée, les Arctic Data Compilation and Appraisal catalogues, que décrit les données océanographiques historiques (courants, hydrocarbures, baleines, etc.). L'approche et la présentation de ces répertoires et séries visent une comparaison facile entre le sujets et les régions.

Il n'est pas possible de fournir tout les répertoires en même temps dans un travail de telle envergure. Les ouvrages de la série actuellement disponibles sont donc indiqués au plat du verso de chaque volume.

Le développement industriel du milieu marin est une activité permanente; on prévoit donc des mises à jour des répertoires. On demande aux lecteurs de faire parvenir leurs corrections et ajouts à l'établissement d'où provient la publication. De telles révisions seront ajoutées à un système interactif de listage et de traitement des données graphiques, des cartes et des rapports spéciaux seront disponibles sur demande.

Mots-clés: Arctique canadian, activités industrielles en milieu marin, repértoire, base de données.


68°
76°
84°
84°
76°
68°
U.S.S.R.
7
3
GREENLAND
ALASKA
4
2
5
6
PACIFIC OCEAN
ATLANTIC OCEAN
1. BEAUFORT SEA
2. NORTHWEST PASSAGE
3. QUEEN ELIZABETH ISLANDS
4. BAFFIN BASIN
5. DAVIS STRAIT
6. HUDSON BAY-FOXE BASIN
7. CANADA BASIN-ARCTIC OCEAN
UNITED STATES OF AMERICA
60°
52°
44°
124°
60°
52°
44°
60°
116°
104°
92°
80°
68°

This map shows the approximate study area covered by this volume, shown in relationship to other arbitrary areas considered in other volumes of this series, and also of the companion series, the Arctic Data Compilation and Appraisal catalogues for historic oceanographic measurements.

VOLUME ABSTRACT

Most industrial activities in the Beaufort Sea region are directly or indirectly associated with the search for oil and gas. Activities in marine areas include dredging, drilling, seismic and sounding surveys, island/camp maintenance, vessel movements, helicopter and fixed-wing flights, and ice-breaking.

Information on seismic and sounding surveys, vessel movements, site-specific activities, and helicopter flights in the Canadian Beaufort Sea from 1980 to 1986 are summarized in this volume. For the 1980-84 period, activities were summarized only for the August 1 - September 10 period. For 1985 and 1986, the time frame of the study was expanded to include the period from June 1 to December 31. The spatial boundaries of the study are west to longitude 141°W (Alaska-Yukon border), east to longitude 127°W, north to latitude 72°N, and south to latitude 68°30'N.

The level of industrial activities increased yearly from 1980 to 1983, peaked in 1984 and 1985, and then sharply declined in 1986, mainly because of the dramatic drop in the world price of oil. The centre of the main industrial zone remained relatively constant from 1980 to 1986.

ACKNOWLEDGEMENTS

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Financial support for this study was provided by the Department of Indian Affairs and Northern Development.

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1. INTRODUCTION

Most industrial activities in the Beaufort Sea region are directly or indirectly associated with the search for oil and gas. Activities in marine areas include dredging, drilling, seismic and sounding surveys, artificial island and camp maintenance, vessel movements, helicopter and fixed-wing flights, and ice-breaking. Activities not directly associated with petroleum exploration are typically vessel and aircraft movements in support of small communities along the Beaufort Sea coast and areas to the east, Distant Early Warning (DEW) sites, mining explorations and operations, natural resource harvesting, and research projects. Many of the recent research projects in the Beaufort Sea have assessed the effects of industrial activities on different aspects of the marine ecosystem.

Information on industrial activities in the Canadian Beaufort Sea is recorded by the individual companies and a brief yearly summary is compiled by the Canada Oil and Gas Lands Administration (COGLA 1983, 1984, 1985, 1986). This information includes: number of wells spudded, reentered and terminated; metres drilled; kilometres of geophysical surveys completed; number of rigs active; number of rig-months; money spent; and volume of resources discovered. Before 1980, COGLA's summary provides the most comprehensive publically available information on seismic and drilling activities in the Beaufort Sea region. In addition two summaries of dredging activities were compiled for the periods 1959 to 1982 (Taylor et al., 1985), and 1982 to 1985 (Sackmann et al., 1986). These two summaries include computerized databases with the following information on dredging activities: start and stop dates, load and dump locations, load and dump volumes, sediment types, water depths at the load and dump sites, dredge name and type, and reference. The accuracy and scope of the information collected by COGLA from the various oil companies, transport companies, and research groups operating in the region is instrumental in allowing better management and planning of exploration and development activities in the region.

For the 1980-84 period, LGL Ecological Research Associates Inc., compiled, analyzed, and mapped information on industrial activities in the Canadian Beaufort Sea as part of a five-year study funded by the U.S. Minerals Management Service (MMS), Department of the Interior. The purpose of the MMS study was to assess the possible effects of industrial activities on bowhead whale behaviour. Activities were summarized for the August 1 to September 10 time period, the time when bowhead whales concentrated in the southeast Beaufort Sea region (Richardson ed., 1985; Richardson et al., 1987).

The Department of Indian Affairs and Northern Development (DIAND) funded complimentary compilations of the relevant information for 1985 (Norton and McDonald, 1986) and 1986 (Norton et al., 1987). These projects were designed in part to delineate the boundaries of a main industrial zone for comparison with the locations of bowhead whale sightings -- an integral requirement of another project for DIAND, "The Beaufort Environmental Monitoring Project" (Indian and Northern Affairs Canada and Environment Canada 1985, 1986).

The design of the 1985 and 1986 industrial activity studies was the same as that of the MMS studies except for the expansion of the time frame to include data from June 1 to December 31 and the inclusion of information on activities in nearshore waters (water depths <10 m). The 1985 and 1986 industrial activity studies are published in separate reports and include summary tables and maps showing activity locations and intensity (Norton and McDonald, 1986; Norton et al., 1987). The data are stored on 5¼ inch floppy diskettes and archived with the Northern Environment Directorate of DIAND, Les Terrases de la Chaudiere, Hull, Quebec.

The present 1988 study is designed to compile, analyze, and summarize four types of industrial activities in the Canadian Beaufort Sea from 1980 to 1986: (1) seismic and sounding surveys, (2) activities at offshore industrial sites, (3) vessel traffic, and (4) helicopter traffic. In part, this study was designed to allow better resource management in the Canadian arctic, and should be useful in regional planning, research monitoring, and environmental impact assesment.

The data for this study were obtained from the companies that conducted the previous industrial activities studies: LGL Limited provided the information for the 1980-84 activities, and ESL Environmental Sciences Limited provided the 1985-86 information. Associated research activity information for 1980 to 1986 is incomplete, and no fixed-wing aircraft data were compiled for 1980 to 1984. Because of the difficulty involved, no research activities or fixed-wing aircraft flights are summarized in this report.

2. HISTORY OF INDUSTRIAL ACTIVITIES IN THE CANADIAN BEAUFORT SEA REGION

Small scale petroleum exploration began onshore in the Canadian Beaufort Sea region in the 1950's, but did not extend offshore until 1972. Occasional dredging activities did occur before 1972, but these were limited to small areas in Tuktoyaktuk Harbour and Tuktoyaktuk Channel (Taylor et al., 1985).

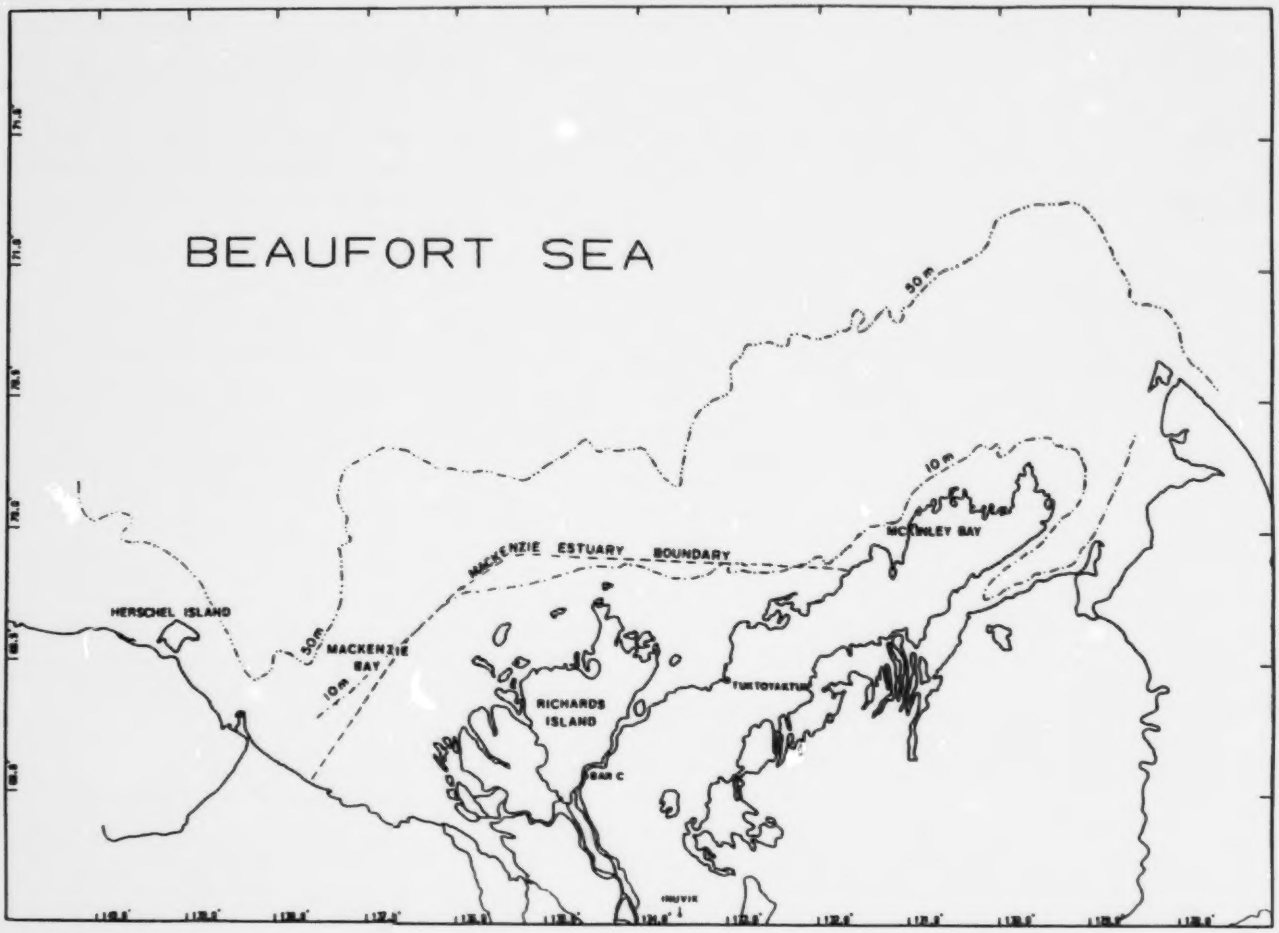
The initial marine drilling sites (in 1972) were limited to locations with water depths less than approximately 2 m. Some of the first artificial islands were constructed during winter. The bottom-fast ice was excavated and cleared from each construction site using heavy land-based equipment working from the ice surface. Trucks hauled fill over the ice from land-based quarries to each site.

Drilling in shallow nearshore marine waters requires construction of a drilling platform. At first, "sacrificial beach" artificial islands were constructed as drilling platforms, requiring high levels of relatively localized vessel and dredging activities. Several types of artificial islands evolved to counter the problems of wave and current erosions, and lateral stresses induced by encroaching ice fields, and differing water depths.

Since 1972, most island structures have taken the form of surface-piercing islands, including "sandbag-retained" and "sacrificial beach" type islands (Sackmann et al., 1986). Fill material was usually delivered from off-site locations, and barge camps housed personnel at the site. Most surface-piercing island construction occurred during the open-water season. Drilling followed, usually during the winter and spring. Land rigs were used to drill from these early drilling platforms.

Most of the early marine industrial sites were located within the Mackenzie estuary or near McKinley Bay (Figure 2-1); Inuvik was the primary support base and much of the vessel traffic was along river channels. Because of the very large fill requirements for construction in deeper waters (i.e. an arithmetical increase in water depth at a proposed artificial island site requires an exponential increase in the volume of fill required), surface-piercing type islands were limited to water depths of less than 20 metres. Issungnak, at a water depth of 18 metres, is the deepest surface-piercing type island constructed in the Canadian Beaufort Sea.

Ships were first used as drilling platforms in the Canadian Beaufort Sea during the open-water period of 1976. During winter, these drillships were moored in one of the few natural harbours in the southeast Beaufort Sea. Prior to the winter of 1979-80, drillships were moored in Pauline Cove (at Herschel Island), or in Summers Harbour near Cape Parry. In the winter of 1979-80 and in subsequent winters, drillships have been moored in McKinley Bay. However, since 1982 Pauline Cove and Wise Bay near Cape Parry have also been used as winter mooring sites for drilling vessels used in the offshore (eg. Kulluk). In late spring, after break-up was well underway, the drillships would proceed as quickly as possible to proposed drill sites. Drilling activities would continue until freeze-up and then the drillships would return to their harbours for winter moorage.


BEAUFORT SEA
50m
10m
MACKENZIE ESTUARY BOUNDARY
McKINLEY BAY
HERSCHEL ISLAND
50m
MACKENZIE BAY
10m
RICHARDS ISLAND
TUKTOYAKTUK
BAR C
INUVIK

Map 2-1: Beaufort Sea Study Area

These drillships limited on-site dredging for the excavation of glory holes intended to protect wells from ice scour impacts. However, the need to have a sufficiently deep winter mooring location that was close to the drilling sites led to the increase in overall dredging activities for the required harbour and access channel. This was especially the case at McKinley Bay where most of the drillships eventually overwintered. In recent years, glory holes have not been dredged, but rather have been drilled with a bit designed specifically for this purpose.

The introduction of the drillships in 1976 also expanded the geographic extent of the industrial area. The cost of operating a drillship in deep water was not as prohibitive as constructing surface-piercing type islands there, and hence drilling activities increased in intensity and quickly expanded into waters deeper than 20 metres and up to 65 metres to date. The dredged harbours for over-wintering the drillships were opened earlier than most other ports in the southeast Beaufort Sea with the use of ice breakers. As a result, vessel traffic occurred earlier in the open-water season and over a greater area than was the case before the arrival of the drillships. Tuktoyaktuk became the primary support base after 1976 because it was closer to the offshore drilling sites at that time than Inuvik.

In 1981 and 1982, respectively, two new types of drilling platforms were introduced in the Canadian Beaufort Sea: the caisson-retained island and the mobile drilling platform supported by a sub-sea berm. Although both of these platforms require a fill base, the volume of fill necessary (and associated construction activities and time) was much less than that required by the "surface-piercing" type islands. The construction of caisson-retained islands and sub-sea berms usually occurred during the open water season, but once built, drilling from these platforms could occur throughout all seasons of the year. Conventional land rigs were used to drill from caisson-retained islands.

The introduction of hopper dredges in 1981 reduced the requirement for barges to transport fill material and hence reduced the total number of vessels required for each island construction. These changes, in conjunction with a government exploration incentive program, decreased the cost, time, and effort necessary to build each drilling platform and, as a result, the number of active sites increased significantly during the 1982-85 period. The number of wells spudded in the Mackenzie Delta-Beaufort Sea region during the 1982-84 period was almost double that during the 1979-81 period, 25 wells as compared with 13 (Canada Oil and Gas Lands Administration, 1987; Department of Indian and Northern Affairs, 1983).

Drilling and dredging are only some of the industrial activities necessary for offshore oil and gas exploration. Other activities include: deep geological seismic (high energy) surveys to examine the underlying geological structures for potential oil-producing formations; shallow (low energy) seismic surveys to examine the surficial geology of the sea floor to two or three hundred metres depth; sounding (very low energy) surveys to locate gravel sources or identify shipping routes; helicopter and fixed-wing flights to transport personnel and supplies between onshore bases and onshore or offshore active sites; and vessel movements to support offshore sites or to maintain ice-free areas around drillship operations.

3. METHODS

3.1 Scope

For the purposes of this report, the study area is west to longitude 141°W (Canada-Alaska border), east to longitude 127°W, south to latitude 68.5°N, and north to latitude 72°N (Figure 2-1). The boundary of the Mackenzie estuary, the locations of offshore active sites (designated by locator codes), the locations of the 20 m and 50 m isobaths, and names of prominent geographic features referred to in this report are also shown on Figure 2-1. The name and location for each of the active site locator codes are listed in Table 3.1-1. Locations that were used for short time periods, such as where icebreakers waited during ice patrols, were not given locator codes but are designated using latitudes and longitudes.

3.2 Data Collection

Information on the 1980-84 industrial activities was obtained from LGL Ltd. in the form of maps, lists of coordinates, and information sheets. The 1985-86 industrial information was taken from the databases on 5¼ inch diskettes archived at ESL.

The procedures followed by LGL and ESL to obtain the original information varied according to the type of activity. The following sections present a brief summary of the format of the original information, the data collection methods, and the completeness of the information base.

3.2.1 Seismic and Sounding Activities

Seismic information is proprietary and can only be obtained with permission from the company which funded the surveys. The locations of the seismic lines and the dates on which they were shot were provided by Geophysical Service Inc. (GSI), Dome Petroleum Ltd., Esso Resources Canada Ltd., Gulf Canada Resources Ltd., and Geoterrex Ltd. Supplementary information was obtained from LGL's own records of seismic vessels observed during bowhead whale studies (Richardson, ed. 1983). GSI provided information on Gulf's 1986 geophysical surveys not available at the time of the 1986 data compilation. The information included date, time, vessel name, and the name and location of the seismic lines shot.

No seismic lines shot in the Alaskan Beaufort Sea and extending east into the study area were included in the database. Some seismic lines were shot for which information is not available.

Table 3.1-1. List of Location Codes for Active Industrial Sites.

CODE	LOCATION NAME	LATITUDE	LONGITUDE
AAG	AAGNERK	69° 45.3'	136° 59.9'
ADG	ADGO	69° 23.6'	135° 51.0'
ADG H	ADGO H-29	69° 28.5'	135° 50.0'
ADG J	ADGO J-27	69° 26.5'	135° 51.0'
ADLR	ADLARTOK	69° 38.7'	137° 45.5'
AIV	AIVERK 2I-45	70° 25.0'	133° 42.0'
AK	ALASKA	69° 41.5'	141° 0.0'
AKL	AKLAVIK	68° 13.0'	135° 0.0'
AKP	AKPAK	70° 15.0'	134° 10.0'
ALERK	ALERK	69° 53.0'	132° 50.0'
AMERK	AMERK P-09	69° 59.0'	133° 31.0'
AML	AMAULIGAK	70° 3.0'	133° 38.0'
AML F	AMAULIGAK F-24	70° 3.0'	133° 37.8'
AML I	AMAULIGAK I-65	70° 5.0'	133° 48.0'
ANG	ANGASAK	70° 13.0'	129° 33.0'
ARL	ARLUK	70° 22.0'	135° 27.0'
ARL E	ARLUK E-90	70° 22.0'	135° 26.5'
ARN	ARNAK (POST 1984)	69° 45.7'	133° 46.3'
ARNO	ARNAK (PRE 1985)	69° 49.0'	133° 52.0'
ATK	ATKINSON POINT	69° 47.0'	132° 5.0'
ATK6	ATKINSON POINT (1986)	69° 56.0'	131° 26.0'
ATT	ATERTAK	69° 30.5'	132° 42.0'
BAI	BAILLIE ISLANDS	70° 33.0'	127° 58.0'
BAR C	BAR C	69° 1.0'	134° 41.0'
BNK	BANKS ISLAND	72° 45.0'	121° 30.0'
C17	CAMP 17	69° 23.6'	135° 51.0'
CDAL	CAPE DALHOUSIE	70° 15.0'	129° 40.0'
CHR	CHAR POINT	70° 7.0'	129° 27.0'
CPAR	CAPE PARRY	70° 12.0'	124° 31.0'
CR.P	CRUMBLING POINT	69° 45.0'	132° 43.0'
DAL	DALHOUSIE AREA	70° 17.2'	129° 45.2'
E AML	EAST AMAULIGAK	70° 4.0'	133° 43.0'
E BAI	EAST BAILLIE	70° 38.0'	128° 0.0'
E HAV	26'EAST OF HAVIK	70° 20.0'	131° 47.0'
E HV	14' EAST OF HAVIK	70° 20.0'	131° 59.0'
E PIT	10 M. EAST OF PITSIULAK	69° 54.0'	136° 16.0'
EDL	EDLOK	69° 45.8'	140° 14.4'
ELL	ELLICE ISLAND	69° 28.0'	135° 55.0'
FIR	FIRTH RIVER	69° 24.0'	139° 51.0'
GRY	GARRY ISLAND	69° 29.0'	135° 46.7'
HAN	HANSON	69° 36.0'	134° 1.0'
HAV	HAVIK B-41	70° 20.0'	132° 13.0'

Table 3.1-1. List of Location Codes for Active Industrial Sites.
(Continued)

CODE	LOCATION NAME	LATITUDE	LONGITUDE
HEN	HENDRICKSON	69° 30.0'	133° 34.0'
HER	HERSCHEL ISLAND	69° 35.0'	139° 5.0'
HERV	HERSCHEL ISLAND (VESSEL)	69° 32.5'	139° 0.0'
HOO	HOOPER ISLAND	69° 42.0'	134° 24.0'
HOO6	HOOPER ISLAND (1986)	69° 41.5'	134° 50.0'
HRB	HERSCHEL BASIN	69° 17.0'	137° 24.0'
HRB5	HERSCHEL BASIN (AIR 1985)	69° 31.6'	138° 54.8'
IMI	IMMIUGAK	69° 45.6'	137° 0.8'
IMM	IMMERK	69° 37.0'	135° 10.0'
INU	INUVIK	69° 20.9'	133° 51.7'
INUA	INUVIK (AIR)	68° 20.0'	133° 51.7'
INUEAST	INUVIK (VIA GRY)	69° 14.0'	135° 34.0'
IRK	IRKALUK B-35	70° 34.0'	134° 10.0'
ISI	ISSIGAK	69° 44.0'	135° 55.0'
ISI4	ISSIGAK (ESSO 1984)	69° 48.0'	136° 0.0'
ISS	ISSUNGNAK	70° 1.6'	134° 18.0'
ISSO	ISSUNGNAK O-61 (PRE 1985)	70° 1.0'	134° 19.0'
ISSERK	ISSERK	69° 56.0'	134° 22.0'
ISSERKO	ISSERK (ESSO 1984)	69° 57.0'	134° 5.0'
ITI	ITIYOK I-27	69° 56.0'	134° 5.0'
KAD	KADLUK O-07	69° 47.0'	136° 1.0'
KAG	KAGLULIK	70° 34.0'	130° 51.0'
KAN	KANNERK	70° 1.0'	131° 13.0'
KAN G	KANNERK G-42	70° 1.0'	131° 31.0'
KAS	KASLUTUT	70° 12.5'	135° 45.0'
KAY	KAY POINT	69° 17.4'	138° 23.2'
KBV	KAUBVIK	69° 52.0'	135° 25.0'
KBV I	KAUBVIK I-43	69° 53.0'	135° 25.0'
KEN	KENALOOAK J-94	70° 43.0'	133° 58.0'
KID	KIDLUIT	69° 31.0'	133° 49.0'
KIG	KIGGAVIK A-43	69° 53.0'	135° 51.0'
KIL	KILANNAK	70° 46.0'	129° 21.5'
KITTI	KITTIGAZUIT	69° 20.9'	133° 42.6'
KMA	KOMAKUK	69° 35.8'	140° 10.6'
KMAV	KOMAKUK (VESSEL)	69° 37.0'	140° 4.0'
KOA	KOAKOAK	70° 22.0'	134° 7.0'
KOG	KOGYUK (N-67)	70° 7.0'	133° 19.0'
KOP	KOPANOAR	70° 24.0'	135° 12.0'
KRI	KRINGALAK	70° 1.0'	136° 28.0'
KUG	KUGMALLIT	69° 38.0'	133° 28.0'
KUJ	KUGDJUK	70° 1.0'	136° 27.0'
KUJO	KUGDJUK (PRE 1985)	70° 1.0'	136° 27.5'
LUC	LUCAS POINT	69° 4.0'	134° 35.0'

Table 3.1-1. List of Location Codes for Active Industrial Sites. (Continued)

CODE	LOCATION NAME	LATITUDE	LONGITUDE
MAI	MAITLAND POINT	70° 10.0'	128° 13.0'
MAS	MASON BAY	69° 36.0'	133° 58.0'
MCK	MCKINLEY BAY	69° 56.8'	131° 14.9'
MIN	MINUK I-52	69° 43.0'	136° 28.0'
MIT	MITERK	70° 40.2'	134° 43.8'
N ISS	NORTH ISSUNGNAK	70° 6.0'	134° 27.0'
N PEL	16 M. NORTH OF PELLY	69° 54.2'	135° 27.3'
NAL	NALLUK	69° 27.0'	132° 59.0'
NAT	NATIAK O-97	70° 4.0'	137° 13.0'
NEK	NEKTORALIK	70° 29.0'	136° 16.0'
NET	NETSERK	69° 33.0'	135° 56.0'
NET0	NETSERK (ESSO 1980-1983)	69° 39.0'	135° 54.0'
NET4	NETSERK (ESSO 1984)	69° 45.4'	135° 49.6'
NHOO0	5 M. NORTH OF HOOPER ISL	69° 47.0'	134° 24.0'
NHOO1	15 M. NORTH OF HOOPER ISL	69° 56.7'	134° 53.2'
NHOO2	17 M. NORTH OF HOOPER ISL	69° 58.7'	134° 53.2'
NIC	NICHOLSON	69° 57.0'	128° 53.0'
NICI	NICHOLSON ISLAND	69° 57.6'	128° 56.0'
NIP	NIPTERK	69° 49.0'	135° 20.0'
NIP0	NIPTERK (PRE 1984)	69° 48.0'	135° 20.0'
NRL	NERLERK	70° 26.0'	133° 20.0'
ORV	ORVILRUK O-3	70° 23.0'	136° 31.0'
PAU	PAULATUK	69° 21.0'	124° 4.0'
PEL	PELLY ISLAND	69° 33.2'	135° 33.2'
PEL6	PELLY ISLAND 1986 (AIR)	69° 44.0'	135° 17.0'
PITS	PITSIULAK A-05	69° 54.0'	136° 46.0'
PITT	PITT ISLAND	69° 18.0'	136° 12.0'
PITT6	PITT ISLAND (1986)	69° 10.0'	136° 12.0'
PLC	PAULINE COVE	69° 34.0'	138° 55.2'
PUL	PULLEN ISLAND	69° 46.5'	134° 19.4'
PULV	PULLEN ISLAND (VESSEL)	69° 49.0'	134° 19.4'
RAE	RAE ISLAND	69° 32.0'	135° 6.0'
S KOG	13 M. SOUTH OF KOGYUK	69° 54.0'	133° 19.0'
S TAR	SOUTH TARSIUT	69° 45.4'	136° 7.0'
SAC	SACHS HARBOUR	71° 59.0'	125° 15.0'
SAR	SARPIK B-35	69° 24.3'	136° 23.0'
SHG	SHINGLE POINT	68° 59.5'	137° 21.0'
STK	STOKES POINT	69° 19.8'	138° 42.9'
SUM	SUMMER ISLAND	69° 36.4'	134° 7.0'
SVL	SIULIK	70° 25.0'	134° 31.0'
TAR	TARSIUT N-44	69° 54.0'	136° 20.0'
TAR4	TARSIUT (ESSO 1984)	69° 54.0'	136° 39.0'
TGL	TAGLU	69° 25.6'	135° 0.5'

Table 3.1-1. List of Location Codes for Active Industrial Sites. (Continued)

CODE	LOCATION NAME	LATITUDE	LONGITUDE
TGLV	TAGLU (VESSEL)	69° 20.3'	135° 33.3'
TKR	TOKER POINT	69° 38.0'	132° 55.0'
TNG	TINGMIARK	70° 10.0'	132° 58.0'
TUF	TUFT POINT	69° 44.0'	132° 33.0'
TUK	TUKTOYAKTUK	69° 26.0'	133° 2.0'
TUKB	TUK BUOY	69° 48.0'	133° 19.0'
UKA	UKALERK	70° 9.0'	132° 44.0'
UKA4	UKALERK (1984)	70° 1.0'	133° 4.0'
UPL	UPLUK	69° 21.0'	135° 28.0'
URK	URKSAK	69° 59.0'	133° 0.0'
UVK	UVILUK P-66	70° 16.0'	132° 18.0'
W ATK	WEST ATKINSON	69° 47.0'	132° 5.0'
W HAV	36' WEST OF HAVIK	70° 20.0'	132° 49.0'
W TAR	WEST TARSIUT	69° 55.0'	136° 25.0'
WHT	WHITEFISH STATION	69° 22.5'	133° 36.0'
WRN	WARREN POINT	69° 45.2'	132° 13.8'
WSE	WISE BAY	70° 6.0'	124° 42.0'

Sounding surveys usually involve a much smaller area and more intensive grid pattern tha the seismic surveys. Sounding information was unavailable for 1980 and 1984, and incomplete for the years 1981-83 and 1985-86. Details on the locations and sizes of the grid patterns and the survey dates were obtained primarily from Dome, Esso, and Gulf.

3.2.2 Vessel Activities

The original information on vessel movements was provided by the oil companies, Arctic Transportation Ltd., Northern Transportation Company Ltd., and Volker Stevin Dredging. Many of the vessels active in the Beaufort Sea region are chartered from transport companies. The oil companies keep records of most vessels in their employ, regardless of the vessel's ownership. Transport companies keep records of other vessel movements for oil companies as well as for transport of supplies to DEW line sites and communities.

The level of detail and method of organization for vessel information varies from company to company. The information is stored either on daily vessel location sheets (which contain the vessel's location at a set time each day and the planned activities for the next 24 hours) or on daily vessel report forms (which contain almost continual information on the vessel's location and activities throughout each 24-hour period) or on dispatcher's log sheets (which contain the times and end points of vessel movements, and comments on vessel activities). The numbers of trips between specific locations were tabulated by vessel per day (1985-86) or by 10-day period (1980-84). For a few of the vessel movements in 1984, it is only known that the trips occurred sometime during the period August 1 to September 10, and more specific information is missing about trip dates. This information is included in the database, but only used in the analysis of the Core Period data. Since many trips span more than one day, interpolation was necessary in assigning a particular trip to a particular day.

Local vessel traffic around offshore sites and drillships was not included in the database. Vessel movements by seismic, sounding, and research vessels were also excluded. Information on movements by dredges, icebreakers, tugs, barges, drillships, and support vessels was included. The LGL (1980-84) database does not contain information on some vessel traffic between coastal sites, because some vessels generally stayed in shallow waters (<10 m). Some vessel activity information is not available: the records are more complete for 1982-86 than for 1980-81, since data compilation began in 1982 and the 1980-81 data had to be acquired retrospectively (Richardson, ed. 1983).

Vessel routes are assumed to have followed straight lines, unless these would cross unnavigable areas. Route midpoints were added arbitrarily in cases where it is assumed that vessels had to navigate beween islands or around shallow areas. Vessel traffic to and from Tuktoyaktuk is assumed to have followed the channel and buoys. Where the exact number of trips between two sites is unknown, the minimum estimate of the number is used.

3.2.3 Helicopter Activities

Records of aircraft movements are kept by the companies funding the activities and not necessarily by the aircraft charter companies. Only Dome, Esso, and Gulf helicopters operated routinely over the eastern Beaufort Sea, and information on these activities was obtained from the respective oil company's records.

Trip endpoints are often described in industry records by the name of a facility or vessel present at that location, e.g., Rig 32 or 'Gulf Beaufort', rather than by a geographic name. The oil companies provided the information on locations of specific rigs and camps. Vessel location information was obtained from actual vessel records. This was possible because the information on vessel movements was obtained before the information on aircraft movements. Hopper dredges were often in transit, and their exact locations at the time the helicopters landed are unknown. In these cases, it is assumed that the dredges spent 50% of the time at the borrow site, and the other 50% at the dump site.

Every take-off and landing is recorded, even if the aircraft was airborne for only a few minutes. Helicopter flights are assumed to follow direct straight-line routes. However, some flights (fewer than one percent) started and finished at the same location, and hence there is no information on the specific flight path because the aircraft destination was not known. These flights are excluded from the database. Flights completely over land are also omitted. Most helicopter activities are well recorded. However, adequate records for 1980 helicopter activities were not available when the data compilation began in 1982, and could not be summarized.

For 1981-84, helicopter data were compiled by 10-day period. For 1985-86, the date of each helicopter trip was documented. As is the case for some 1984 vessel data, the dates of some 1984 helicopter trips are not known (even within a 10-day period), although it was known that these trips did occur sometime during the Core Period (i.e. August 1 to September 10). These data are in the database, but are analyzed only for the Core Period summary.

LGL did not compile information on 1980-84 fixed-wing aircraft flights, except for flights made during whale surveys. Flights between onshore locations and ice reconnaissance flights were almost all at altitudes greater than 457 m (1500 ft) a.s.l., and irrelevant for present purposes. Information on 1985-86 fixed-wing aircraft flights for oil companies was compiled by ESL. The large majority of non-research aircraft flights in 1985 and 1986 were by helicopter (97.9% and 94.2% respectively). Because few data on fixed-wing aircraft flights in 1980-86 are available, no fixed-wing aircraft data are summarized in this report.

3.3 Data Entry and Tabulation

The 1980-84 industrial activities information was obtained by ESL from LGL in the form of maps, data sheets, and "trip matrices" (number of trips in a 10-day period between every combination of endpoints). The time period covered by this information is August 1 to September 10 of each year, except for 1981 for which information from July 22 to July 31 was also included.

LGL was unable to provide a list of locations, dates, and survey types of geophysical research activities conducted in the eastern Beaufort Sea prior to 1984. Instead, information on these activities in 1980-83 was provided by LGL in the form of 1:1,000,000 grid maps on which seismic and sounding activity data are plotted by 10-day time period. The different seismic and sounding methods used are shown by various linetypes and symbols. The start and end points of the lines shot, the latitudes and longitudes of sounding locations, and the boundaries of high-intensity seismic and sounding surveys were read from these maps. These data along with the time period and survey type were then entered into a dBase III+ database file with a format identical to that of the 1985-86 seismic data. Seismic data for 1984 were provided by LGL in two formats: (i) data sheets listing the line designation, date, vessel, and the location for seismic lines shot between July 11 and September 30, 1984, and (ii) maps for the four 10-day periods from August 1 to September 10 on which the seismic and sounding activities are plotted. Some inconsistencies were found between the raw data provided by LGL and the published maps. In these cases, the data on the published maps are assumed to be correct, since the maps incorporated various corrections made by LGL during their original data compilation.

The 1980-84 vessel and helicopter traffic information was provided as trip matrices for each 10-day period. The matrices show the number of times that a trip was made between two sites during a particular 10-day period. These sites are generally designated by well name or geographic name. For a small number of trips, the latitude and longitude of a site could not be determined. Trips to or from these sites have been omitted from the database.

The 1985 and 1986 data were taken from the archived 5¼ inch floppy diskettes at ESL. Helicopter and fixed-wing aircraft data were contained in one file. Based on the model or call number, the helicopter information was distinguished from the fixed-wing aircraft information and stored in a separate data file. No changes were made to either the seismic activity data files or the vessel traffic data files for 1985-86. Research activity information in those years was not used in this compilation.

The Ashton-Tate dBase III+ data management system was used in the design of a microcomputer database for storage of all relevant industrial activities information. A unique database structure was established for each activity group (seismic, vessel, helicopter, and fixed-wing aircraft). The structure of the helicopter and fixed-wing aircraft databases is identical. The four dBase III+ data files are entitled "SEISMIC.DBF", "VESSEL.DBF", "HELCOPTR.DBF", and "FAIRCRFT.DBF". The file structures of the industrial activities data files and of the data file containing the locator codes, "LOCATION.DBF", are presented in Appendix A.

The 1980-86 industrial activity database files are stored on 5¼ inch floppy diskettes. A complete copy of the database was provided to the Department of Indian Affairs and Northern Development, Yellowknife, and the Institute of Ocean Sciences, Sidney, for archiving.

3.4 Computer Mapping

Maps showing temporal and spatial variations were produced for three activity categories: (1) seismic and sounding surveys, (2) vessel traffic, and (3) helicopter traffic. Activities at offshore locations were plotted on the maps of vessel traffic and helicopter traffic.

A dBase III+ conversion program was written to convert the main data files into a format for production of user-requested plots of the various activities. The information required for each plot, written to a temporary file, included the latitudes and longitudes of the start-points, mid-points (if any), and stop-points for each trip; and the time period, the year and the number of times each trip was made.

Mid-points are additional location information required to define vessel trips, i.e. points that define routings around unnavigable areas between each trip's start-point and stop-point. Mid-points were not usually required to define aircraft trips, i.e. aircraft flight paths are usually direct from their start point to their destination. The 1980-84 vessel data required the definition of new mid-points for several trips. The existing database for 1985 and 1986 vessel activities had mid-points defined for all required trips. A maximum of three mid-points was assigned to any particular vessel trip. Vessel traffic in the river channels is not mapped; vessel trips to Inuvik is mapped as far as the mouth of East Channel (see "INU" location on Figure 2-1). Aircraft trips to or from Inuvik use the actual site of Inuvik as the start- or stop-point.

The dBase III+ conversion program separates vessel and aircraft movements into their component trip segments. Vessel trips with no mid-points, and helicopter and fixed-wing aircraft trips would consist of one trip segment -- defined by the start-point and the end-point of the trip. Vessel trips with routes around unnavigable areas are separated into more than one trip segment. Each trip segment was then written to the plot file. However, if the trip segment had already been entered in the file for that specific time period, a new record would not be written for plotting, but rather the field containing the number of trips would be increased by the number of trips listed in the duplicate record. Thus, each trip segment was plotted only once for each time period. Replotting trip segments that were frequently travelled causes a poor-quality final product, i.e. ink smears and paper tears from multiple pen passes. The plotted trip segments represent the best approximation of the centre line of a particular traffic corridor. This corridor in some cases was probably several kilometres wide. Thus, it is unlikely that traffic at a particular point along a route would be as intense as that indicated on the maps.

The plot files for vessel and helicopter trips contain seven fields defining the time period, year, number of trips, and the latitudes and longitudes of the end-points of each trip segment. The plot files for seismic and sounding activities are in slightly different formats, i.e. no field is required for the number of trips (because a given seismic line is rarely shot more than once at the same location); an extra field is required to denote the type of seismic or sounding survey conducted (because different line types or symbols are required to plot each survey type).

Each activity plot file was plotted by time period on a base map of the Beaufort Sea (scale approximately 1:3,300,000) using a Hewlett-Packard 7550 plotter. The frequency of use of each trip segment is shown by different line type or thickness. Three frequency ranges are selected: 1 to 10 trips per time period (thin dashed line), 11 to 50 trips per time period (thin continuous line) and greater than 50 trips per time period (thick continuous line). Activities are plotted for each year by 10-day period from August 1 to September 10. Additional summary maps are plotted for 1985 and 1986 data for the months of June, July, August, September, October, and December, to allow direct comparisons between activity frequencies in the various months.

The types of site-specific activities occurring at offshore locations are shown by symbols on the maps of vessel and helicopter activities. Separate symbols are used to depict the following activities: borrow site/dredge, island or caisson drilling, island/other activity, and drillship. Dredging includes removing the surface layer of the sediment before construction of an island or berm, digging glory holes and obtaining fill material. Activities included in the category island/other activity include setting up and dismantling rigs, and island maintenance and clean-up.

3.5 Definition of the Main Industrial Zone

Previous studies of industrial activities in the southeast Beaufort Sea (Richardson ed. 1983, 1984, 1985; Duval, 1986; Norton et al., 1987) defined a main industrial zone (MIZ), where island construction, drilling, and heavy vessel and aircraft traffic occur. In the past, the procedures used to define the MIZ were somewhat inconsistent and arbitrary. This made it difficult to draw conclusions from comparisons of year-to-year variations in the MIZ (Norton et al., 1987).

In this report, a composite map prepared for each year displays all of the various industrial activities that occurred during the Core Period. Although interpretation of these maps is subject to many of the same limitations associated with previous definitions of the MIZ, qualitative comparisons of the level and scope of annual industrial activities were easier to make and are perhaps more valid.

4. DESCRIPTION OF THE 1980-86 INDUSTRIAL ACTIVITIES

The following sections briefly summarize the 1980-86 industrial activities by year and by activity group. Computer-drawn maps of the various activity types are presented by 10-day period in Appendix B.

4.1 1980 Industrial Activities

The level of industrial activities in the Canadian Beaufort Sea during the 1980 study period was greater than in previous years (Richardson et al., 1987), but lower than in succeeding years, except for 1986. Only two oil companies, Esso Canada Resources Ltd, and Dome Petroleum Ltd. operated offshore in 1980.

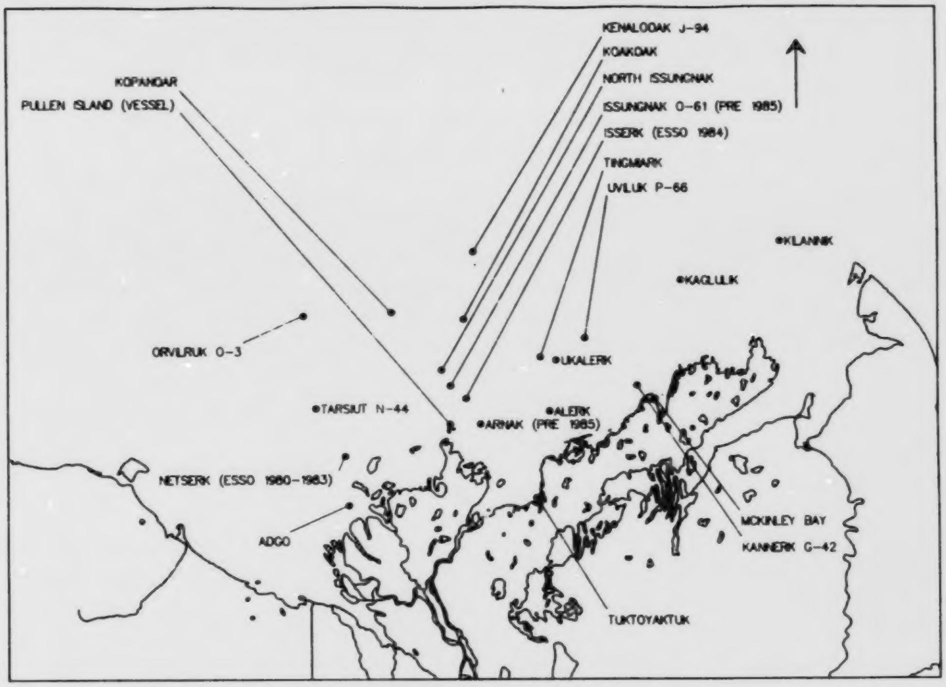
A plot of active industrial sites in 1980 is given in Map 4.1-1a. Map 4.1-1b shows a composite plot of the major industrial activities in the Canadian Beaufort Sea in 1980. As a caution, the reader should note that the different line types that are displayed on composite plots in this report are not indicative of any one specific type of industrial activity, rather they may be indicative of several different types of activities. For example, in Map 4.1-1b, a dashed line represents seismic activities using sleeve exploders (see Map 4.1-2) and a vessel route traversed 10 or fewer times during 1980 (see Map 4.1-3). The 1980 composite plot shows the western edge of most industrial activities was bounded by activities at Orvilruk and Tarsiut, a site of intense seismic activity in 1980. Kaglulik and McKinley Bay define the eastern extents of the most active zone. Very few industrial activities occurred north of Kenalooak (70°43'N 133°58'W) in 1980.

4.1.1 Seismic and Sounding Activities

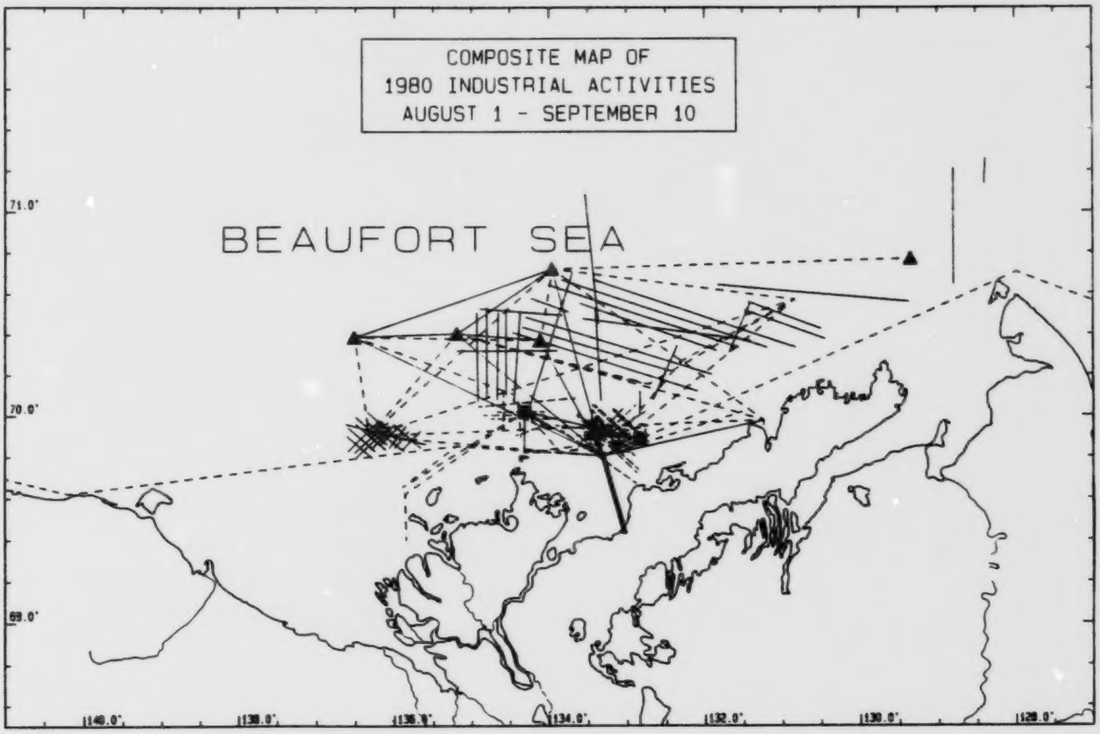
Seismic exploration during 1980 was undertaken by two vessels. The GSI Mariner shot seismic lines using a large airgun array (shown as solid lines on the maps). The Arctic Surveyor used an array of 12 large sleeve exploders to conduct seismic surveys (depicted as dashed lines -- see Map 4.1-2).

Few seismic surveys in 1980 were known to extend west beyond 136°W or north beyond 71°N; surveys were generally within 100 km of the Northwest Territories coast. Additional seismic exploration other than that shown on the maps occurred during the summer of 1980, but locations and times of these activities are not known (Richardson ed., 1983). In terms of kilometres of seismic lines shot, activity was greatest during the August 1 - 10 period and tended to decrease into September. (See Figure 4.1-1).

Low-energy sounding surveys were made in 1980, but this information is not available (Richardson ed., 1983).


KENALOOAK J-94
KOAKOAK
NORTH ISSUNGNAK
ISSUNGNAK O-61 (PRE 1985)
ISSERK (ESSO 1984)
TINGMIARK
UVILUK P-66
KOPANOAR
PULLEN ISLAND (VESSEL)
KLANNIK
KAGLULIK
ORVILRUK O-3
UKALERK
TARSIUT N-44
ALERK
ARNAK (PRE 1985)
NETSERK (ESSO 1980-1983)
ADGO
MCKINLEY BAY
KANNERK G-42
TUKTOYAKTUK

Map 4.1-1a: 1980 Active Industrial Sites.


COMPOSITE MAP OF
1980 INDUSTRIAL ACTIVITIES
AUGUST 1 - SEPTEMBER 10
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

Map 4.1-1b: All 1980 Industrial Activities.

4.1.2 Site-Specific Activities

Activities at offshore sites in 1980 are shown on the maps of vessel activities in Appendix B.

Throughout the summer of 1980, Dome drillships were present at Koakoak, Kopanoar, and Orvilruk. A fourth Dome drillship was active at the Kenalooak site until September 8, and then moved to Kilannak. No other drilling was done during the 1980 Core Period. Two dredges were active in the Canadian Beaufort Sea in 1980. Until late August, the suction dredge Beaver Mackenzie operated at Issunnak. It then started dredging activities at Alerk. A second suction dredge, the Aquarius, dredged in McKinley Bay.

4.1.3 Vessel Activities

The level of vessel activities remained very constant throughout the study period (see Figure 4.1-2). Most trips were made by crew-change boats, tugs and barges, and dredges. Trips by research vessels or in shallow waters (depths <10 m) are not shown. The majority of vessel movements were between offshore sites and Tuktoyaktuk in support of drilling and island construction activities. Several Northern Transportation Company Ltd. (NTCL) vessels travelled to points east and west of the study area (see Map 4.1-3).

4.1.4 Helicopter Activities

At least five twin-engine turbine helicopters operated offshore in 1980, but specific information on helicopter traffic is not available for that year.

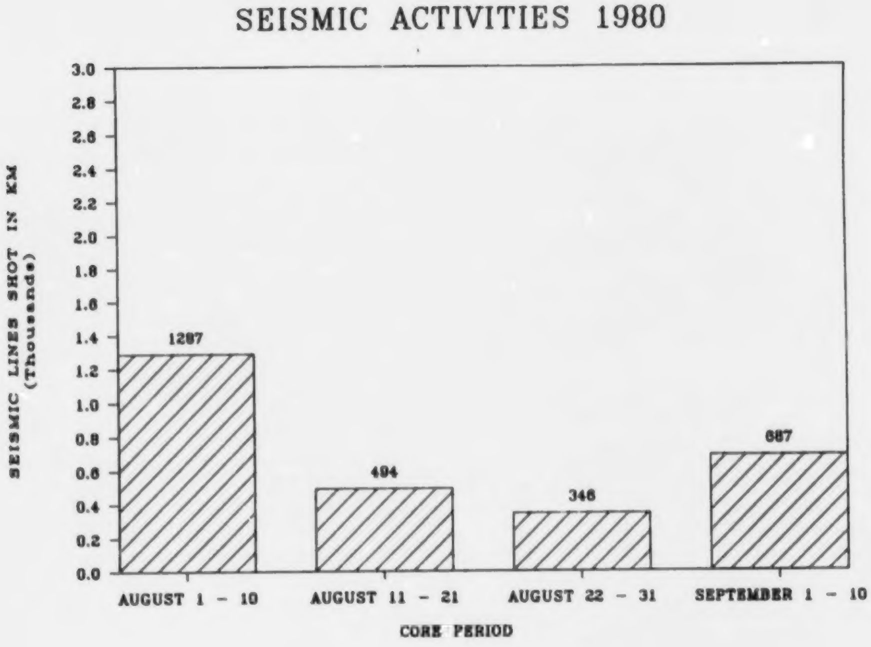
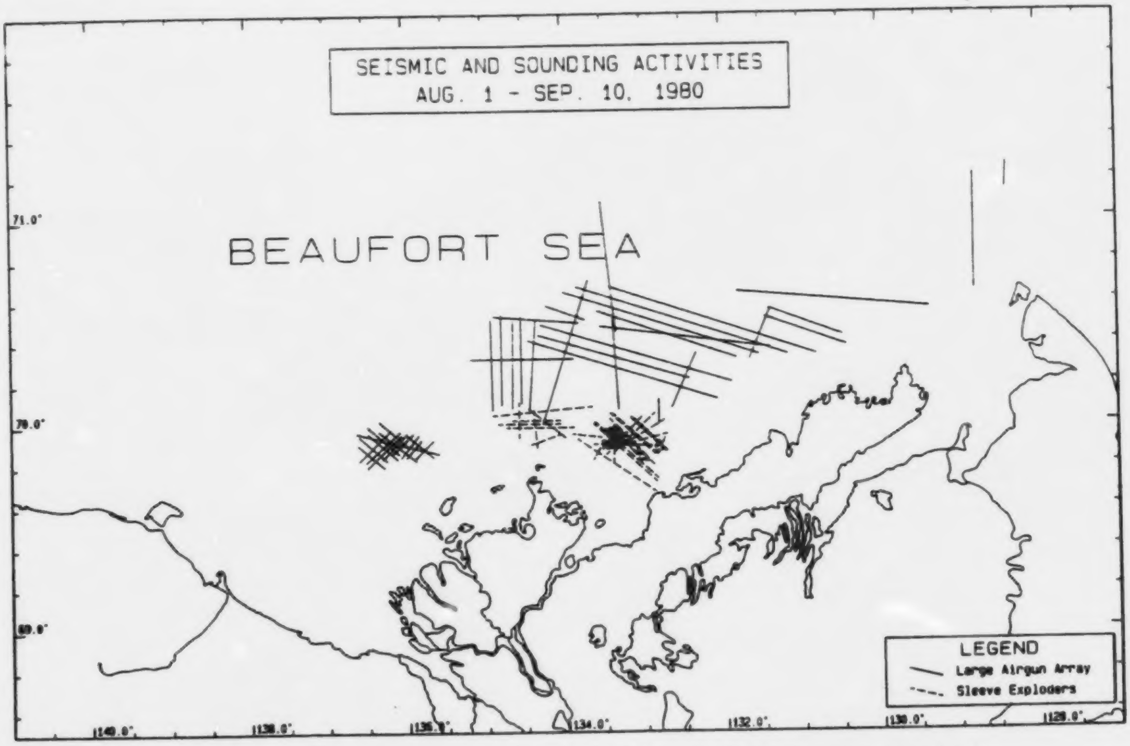


Figure 4.1-1: Seismic Activities 1980 Core Period


SEISMIC AND SOUNDING ACTIVITIES
AUG. 1 - SEP. 10, 1980
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Sleeve Exploders

Map 4.1-2: Seismic Activities 1980 Core Period

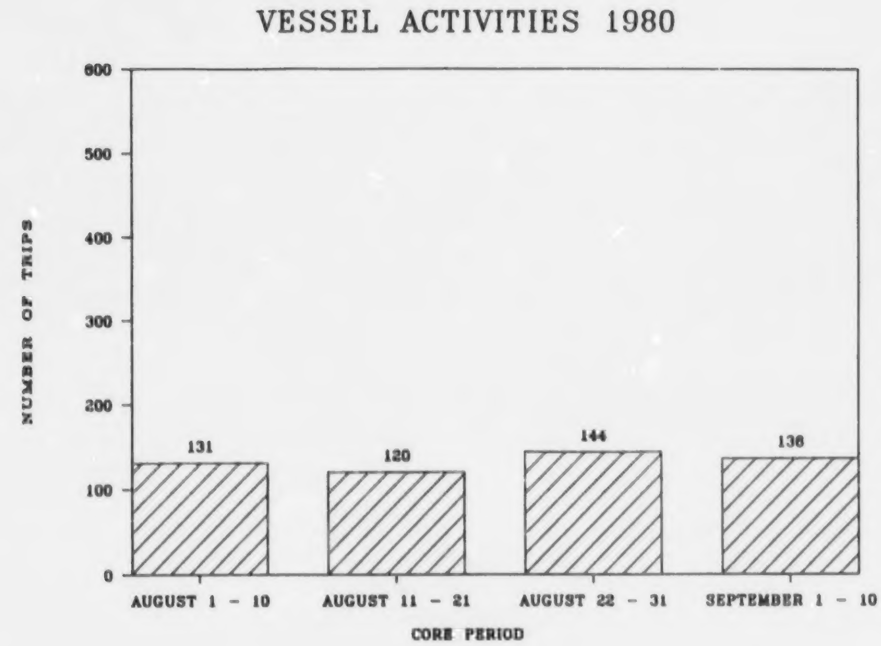
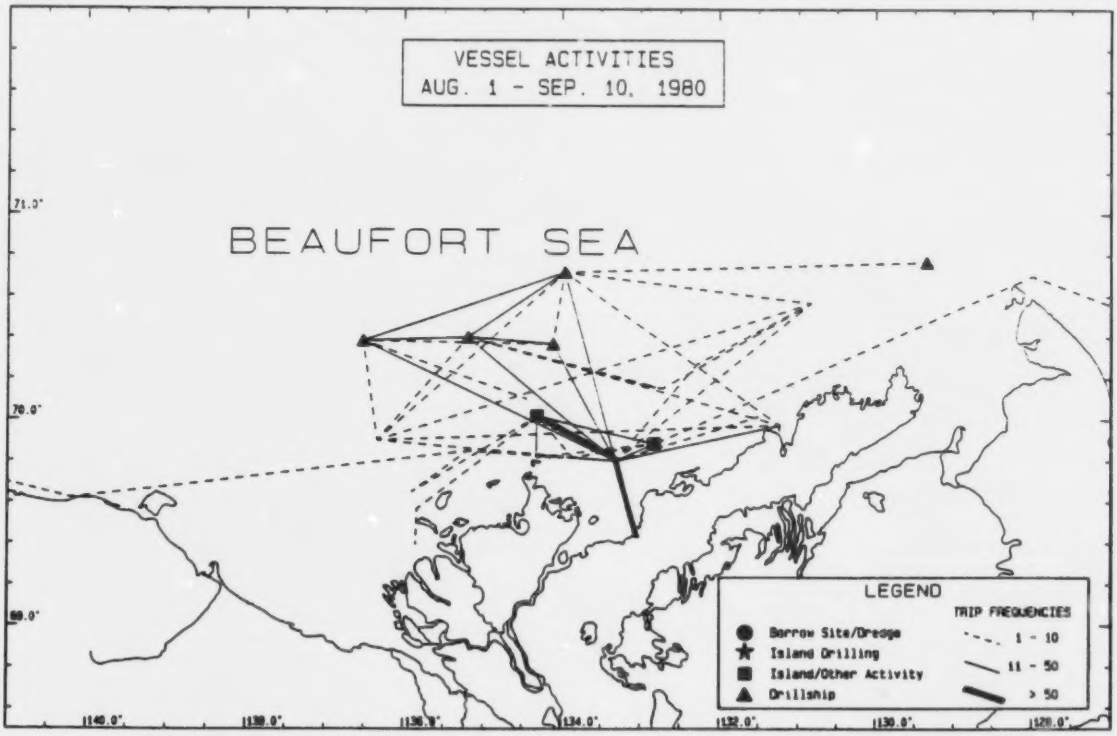


Figure 4.1-2: Vessel Activities 1980 Core Period


VESSEL ACTIVITIES
AUG. 1 - SEP. 10, 1980
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

Map 4.1-3: Vessel Activities 1980 Core Period

4.2 1981 Industrial Activities

The level of industrial activities increased in 1981, but was lower than that in 1982. Three oil companies operated offshore in 1981: Dome, Esso, and Gulf.

A composite plot of all industrial activities in 1981 shows that the area of intense industrial activities was significantly larger in 1981 than in 1980 (see Maps 4.1-1b and 4.2-1b). Gulf's barge camp at Herschel Island in the west and Dome's drillship at Killanik in the east define the east-west extents of the zone of most intense industrial activities.

4.2.1 Seismic and Sounding Activities

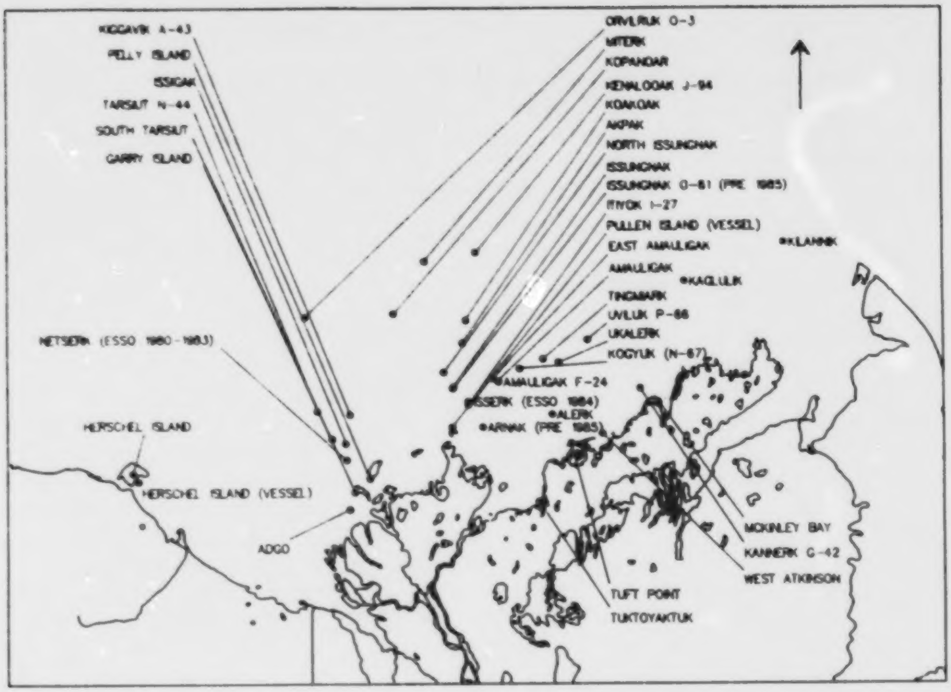
At least three vessels conducted high-energy surveys in the Canadian Beaufort Sea in 1981: the GSI Mariner and the Edward O. Vetter used large airgun arrays, and the Arctic Surveyor shot seismic lines using an array of sleeve exploders. The level of seismic activities during the 1981 Core Period was greater than for any other year in this study. Seismic activity was most intense in mid and late August: almost 2400 km of line were shot between August 22 and 31 (see Figure 4.2-1).

The known area of seismic exploration was expanded from 1980. Seismic lines were shot in Mackenzie Bay and north of Richards Island in late July; north of Richards Island in early August; from Mackenzie Bay to Baillie Island in mid and late August; and north of Richards Island and west of Herschel Island in early September (see Map 4.2-2). Additional seismic lines were shot in 1981, but specific information on these is not available (Richardson ed., 1985).

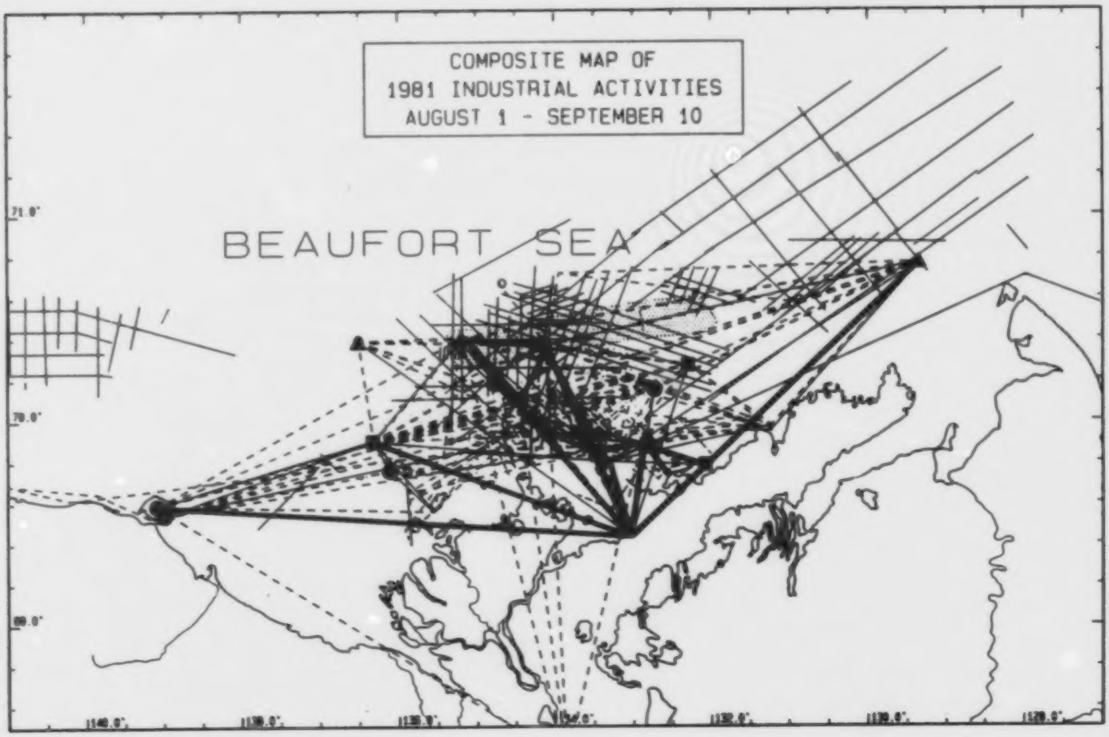
Sounding activities were also intense in 1981. In late July and August, the CSS Hudson conducted sounding surveys in a 20 km wide strip from the Mackenzie Delta to about 70 km north of Atkinson Point (see maps Appendix B). At least five other vessels did sounding surveys -- most at specific sites in the Mackenzie Delta and north of the Tuktoyaktuk Peninsula.

4.2.2 Site-Specific Activities

As in 1980, drilling in the Canadian Beaufort Sea during the late summer of 1981 was conducted from the four Dome drillships, Canmar Explorer I, II, III, and IV. Drillships were located at Koakoak, Kopanoar, and North Issungnak throughout the study period. A fourth drillship was at Kilannak until September 5 and then moved to Orvilruk. Drilling from a caisson-retained island commenced at Tarsiut in the winter.


KIGGAVIK A-43
PELLY ISLAND
ISSIGAK
TARSIUT N-44
SOUTH TARSIUT
GARRY ISLAND
NETSERK (ESSO 1980-1983)
HERSCHEL ISLAND
HERSCHEL ISLAND (VESSEL)
ADGO
ORVILRUK O-3
MITERK
KOPANOAR
KENALOOAK J-94
KOAKOAK
AKPAK
NORTH ISSUNGNAK
ISSUNGNAK
ISSUNGNAK O-61 (PRE 1985)
ITIYOK I-27
PULLEN ISLAND (VESSEL)
EAST AMAULIGAK
AMAULIGAK
KAGLULIK
KILANNIK
TINGMIARK
UVILUK P-66
UKALERK
KOGYUK (N-67)
AMAULIGAK F-24
ISSERK (ESSO 1984)
ALERK
ARNAK (PRE 1985)
MCKINLEY BAY
KANNERK G-42
WEST ATKINSON
TUFT POINT
TUKTOYAKTUK

Map 4.2-1a: 1981 Active Industrial Sites.


COMPOSITE MAP OF
1981 INDUSTRIAL ACTIVITIES
AUGUST 1 - SEPTEMBER 10
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

Map 4.2-1b: All 1981 Industrial Activities.

The level of dredging activities increased in 1981. Two suction dredges and two hopper dredges operated in the study area. Construction of the first caisson-retained islands in the Canadian Beaufort started in water 23 m deep at Tarsiut and 31 m deep at Uviluk. Additional information on 1980-85 dredging is reported in Sackmann _et_ _al._ (1986).

4.2.3 Vessel Activities

Vessel traffic was more intense in 1981 than in 1980; Dome and Esso alone operated 35 vessels in the area. Over 950 trips were logged during the Core Period compared with fewer than 550 for the same period in 1980. The level of vessel activities was fairly stable throughout the month of August (see Figure 4.2-2). The geographic extent of vessel activities increased as well. Most vessel traffic was from Tuktoyaktuk to offshore sites and between offshore sites in support of island construction activities, but trips were also made to points west and east of the study area. Herschel Island was visited regularly. (See Map 4.2-3)

4.2.4 Helicopter Activities

About seven twin-engine turbine helicopters operated offshore in 1981. This was an increase of two from 1980. Helicopter movements were concentrated in the same area as vessel movements. Helicopters regularly travelled to and from Herschel Island, but none flew to points outside the study area. The number of helicopter trips made during each 10-day period was relatively stable throughout Core Period (see Figure 4.2-3, Map 4.2-4).

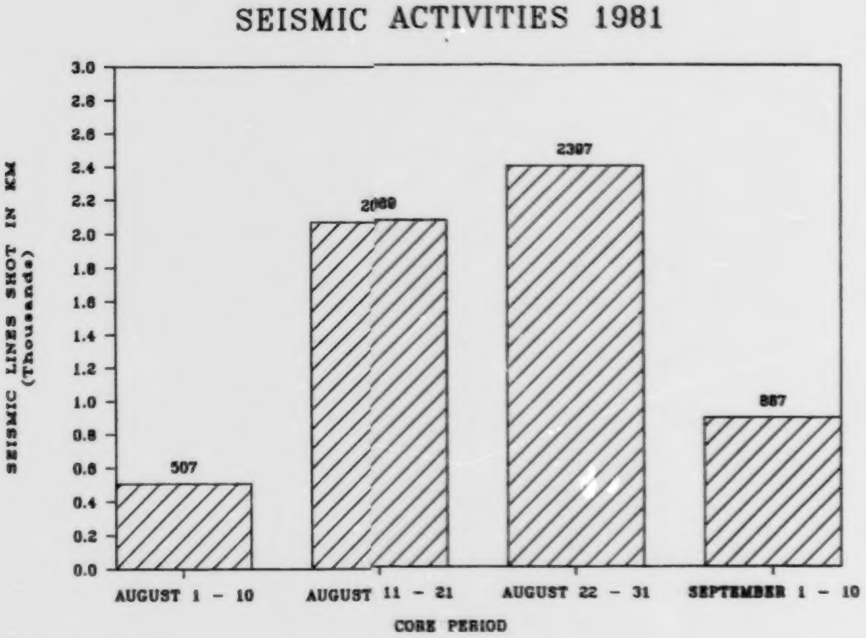
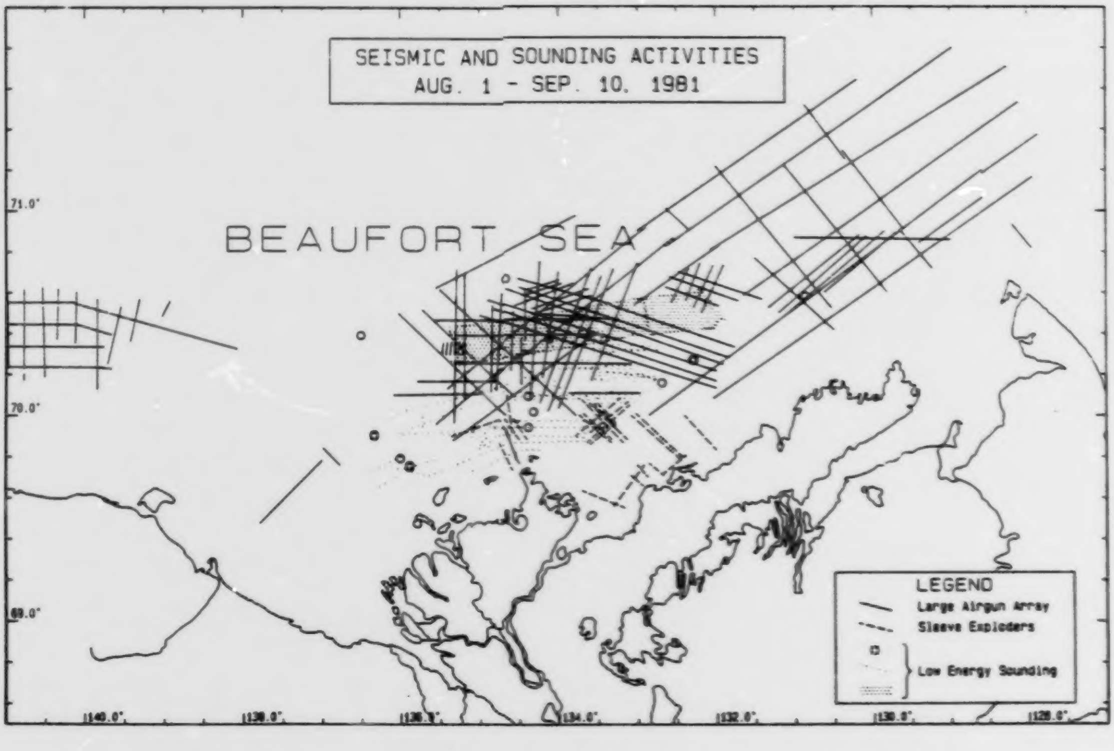


Figure 4.2-1: Seismic Activities 1981 Core Period.


SEISMIC AND SOUNDING ACTIVITIES
AUG. 1 - SEP. 10, 1981
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Sleeve Exploders
Low Energy Sounding

Map 4.2-2: Seismic Activities 1981 Core Period.

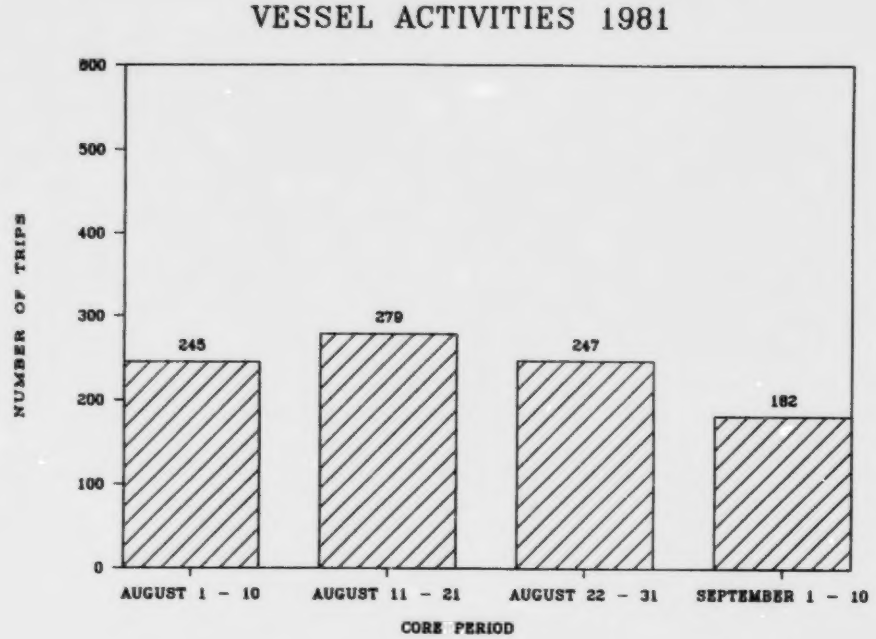
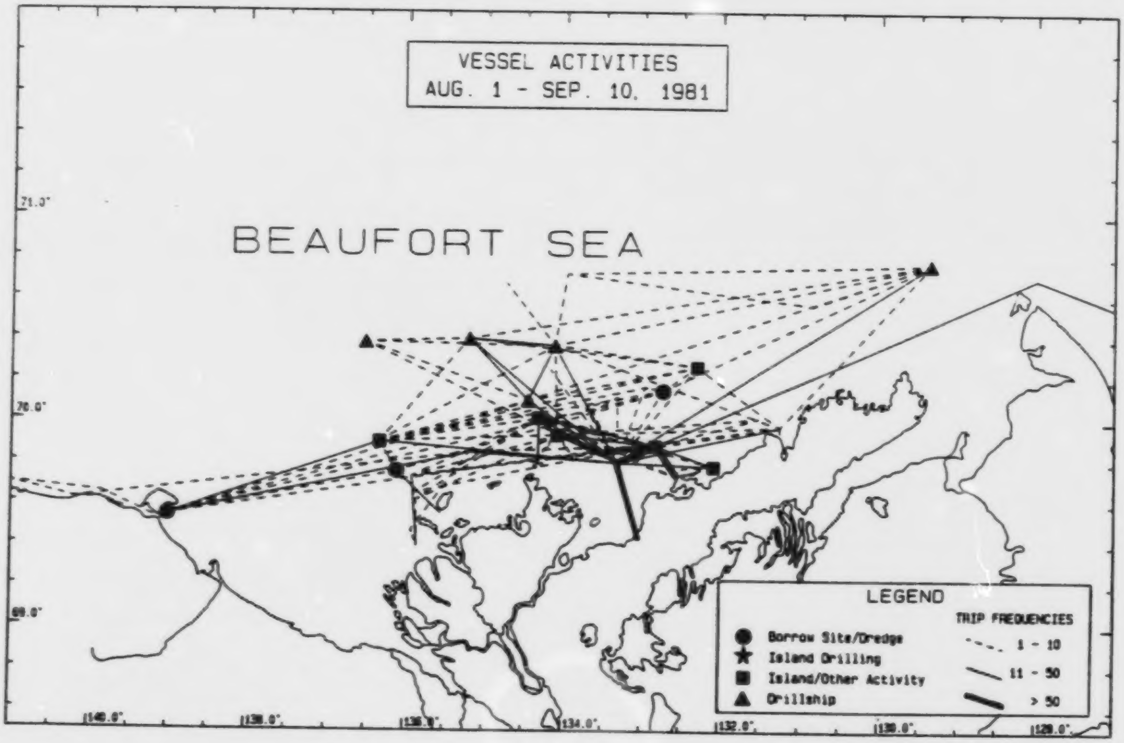


Figure 4.2-2: Vessel Activities 1981 Core Period.


VESSEL ACTIVITIES
AUG. 1 - SEP. 10, 1981
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
TRIP FREQUENCIES
1 - 10
11 - 50
> 50

Map 4.2-3 Vessel Activities 1981 Core Period.

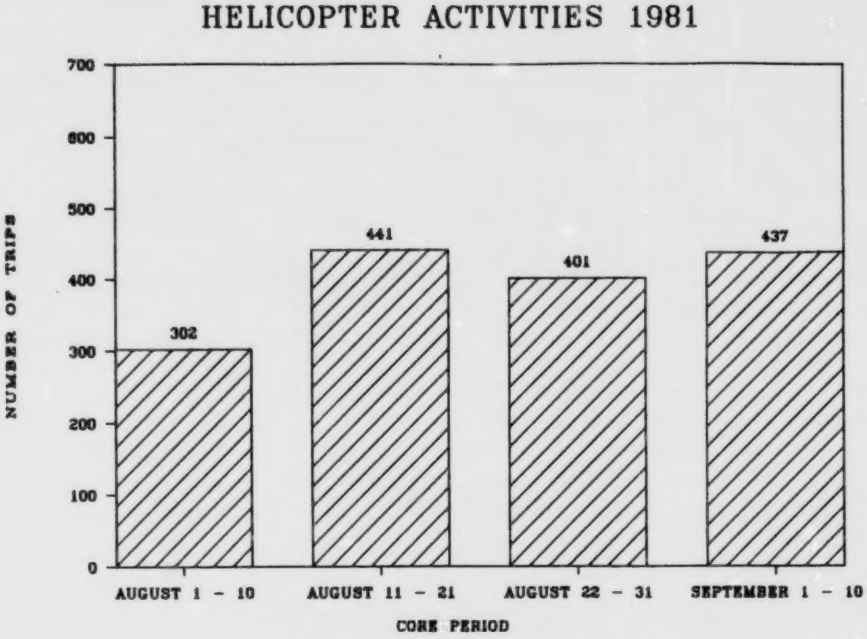
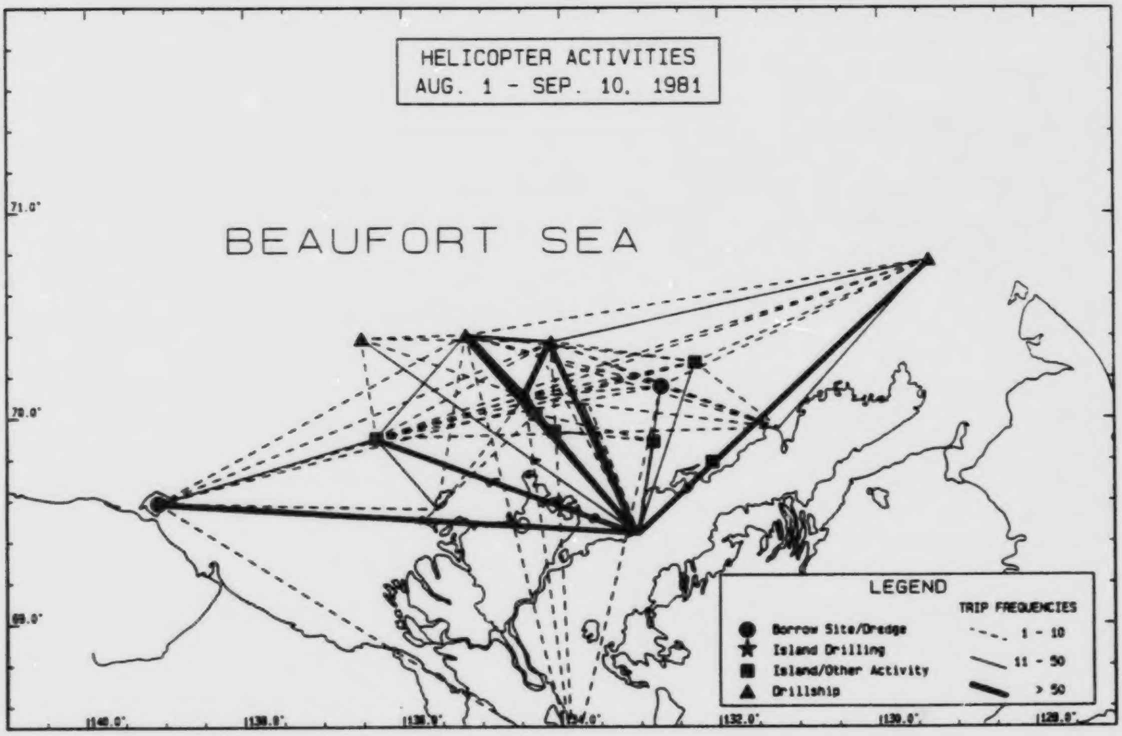


Figure 4.2-3: Helicopter Activities 1981 Core Period.


HELICOPTER ACTIVITIES
AUG. 1 - SEP. 10, 1981
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

Map 4.2-4: Helicopter Activities 1981 Core Period.

4.3 1982 Industrial Activities

Offshore industrial activities in the Canadian Beaufort Sea in 1982 were more numerous than in any previous year. Dome, Esso, and Gulf were the principal operators.

The active industrial sites in the Canadian Beaufort in 1982 are shown in Map 4.1-1a. Map 4.1-1b is a composite plot of all 1982 industrial activities. The boundary of the most active region extended from Tuktoyaktuk eastward to McKinley Bay, to Kenalooak (where a drillship operated), westward to Orvilruk (where another drillship was located), southward to Tarsiut, and back to Tuktoyaktuk.

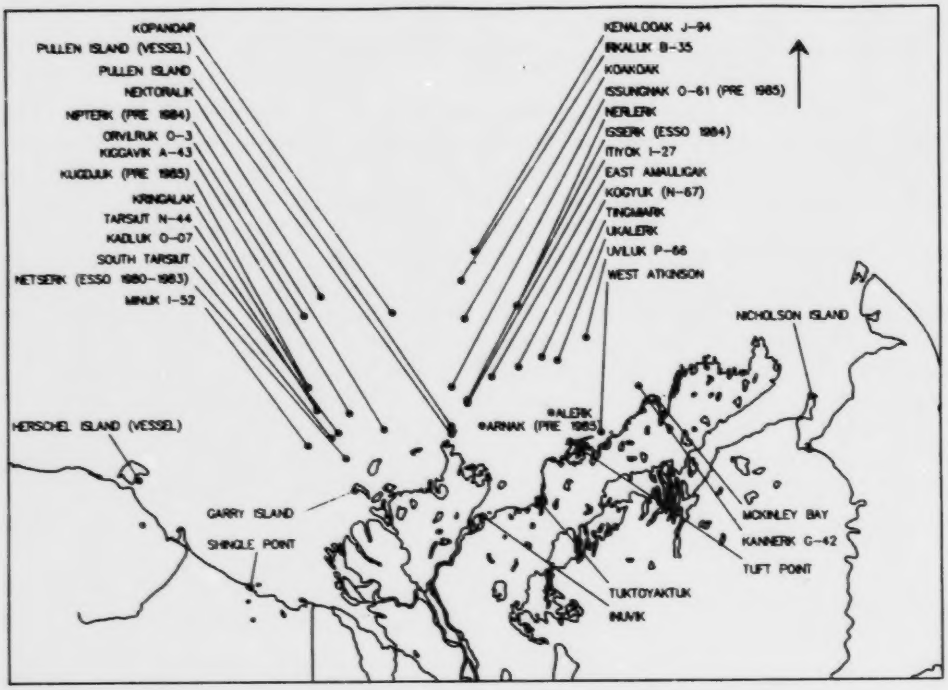
4.3.1 Seismic and Sounding Activities

The level of seismic activities decreased in 1982. The most active 10-day period was in August when almost 1400 km of lines were shot (see Figure 4.3-1). The Arctic Surveyor shot lines off the Yukon coast using open-bottom gas guns, and the Canmar Teal operated airguns north of Richards Island. The same vessels were active off the Yukon coast and Tuktoyaktuk Peninsula later in August and in September (see Map 4.3-2). The long continuous seismic lines on Figure 4.3-2 were shot by the GSI Mariner. Seven vessels conducted sounding surveys during the study period. Sounding sites were concentrated off the coast of Richards Island and western Tuktoyaktuk Peninsula. A total of about 26 sites were visited, most of which were less than 1 km^2 in size (see maps Appendix B).

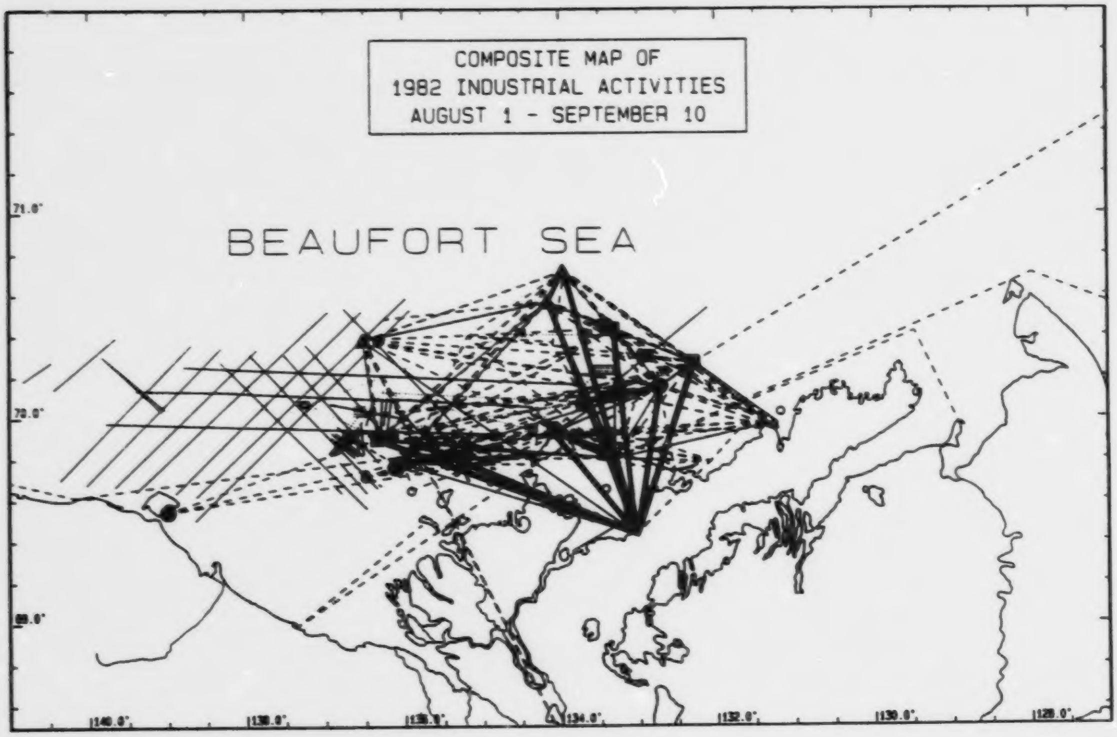
4.3.2 Site-Specific Activities

The four Dome drillships were again active in 1982. Drillships operated at Kenalooak, Irkaluk, and Kiggavik during the entire Core Period. The fourth drillship remained at Nerlerk until the end of August and then moved to Orvilruk. Drilling at Tarsiut ended in early August, but other operations continued into September.

Dredging activities increased in 1982 when six dredges operated, compared to four in 1981. Island construction activities occurred at Kadluk, Itiyok, Kogyuk, East Amauligak, Ukalerk, and Nerlerk. Island clean-up occurred at Alerk until early August.


KOPANOAR
PULLEN ISLAND (VESSEL)
PULLEN ISLAND
NEKTORALIK
NIPTERK (PRE 1984)
ORVILRUK O-3
KIGGAVIK A-43
KUGDJUK (PRE 1985)
KRINGALAK
TARSIUT N-44
KADLUK O-07
SOUTH TARSIUT
NETSERK (ESSO 1980-1983)
MINUK I-52
KENALOOAK J-94
IRKALUK B-35
KOAKOAK
ISSUNGNAK O-61 (PRE 1985)
NERLERK
ISSERK (ESSO 1984)
ITIYOK I-27
EAST AMAULIGAK
KOGYUK (N-67)
TINGMIARK
UKALERK
UVILUK P-66
WEST ATKINSON
NICHOLSON ISLAND
ALERK
ARNAK (PRE 1985)
HERSCHEL ISLAND (VESSEL)
GARRY ISLAND
SHINGLE POINT
MCKINLEY BAY
KANNERK G-42
TUFT POINT
TUKTOYAKTUK
INUVIK

Map 4.3-1a: 1982 Active Industrial Sites.


COMPOSITE MAP OF
1982 INDUSTRIAL ACTIVITIES
AUGUST 1 - SEPTEMBER 10
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

Map 4.3-1b: All 1982 Industrial Activities.

4.3.3 Vessel Activities

The records of vessel movements in 1982 were more complete than in previous years. Nevertheless, fewer vessel trips were recorded in 1982 than in 1981; 849 trips were made during the 1982 Core Period compared with 953 trips in 1981 (see Figure 5.1-8). The intensity of 1982 vessel activities was relatively constant throughout the 1982 Core Period (see Figure 4.3-2) and mainly in support of drilling, dredging, and island construction activities between Tuktoyaktuk, McKinley Bay, and the various offshore sites. Vessel operations were restricted to a smaller area than in 1981: traffic to the east was reduced because Killanik was not an active site as it had been in 1981, and fewer trips were made to Herschel Island. There was some activity farther to the north at Kenalooak, where a drillship operated. In early and mid August, dredges made several trips to Banks Island. Several trips were also made to points east and west of the study area (see Map 4.3-3).

4.3.4 Helicopter Activities

Although one more helicopter operated offshore in 1982 than in 1981, helicopter activities were somewhat less intense in 1982 than in 1981. The level of helicopter activities remained relatively stable throughout the Core Period (see Figure 4.3-3). Most helicopter traffic, like most vessel traffic, was in support of offshore sites, and restricted to sites in the Mackenzie Delta and off western Tuktoyaktuk Peninsula (see Map 4.3-4). No trips were logged to Herschel Island or Kilannak during the Core Period in 1982, hence the area of intense activities did not extend as far to the west or east in 1982 as they did in 1981.

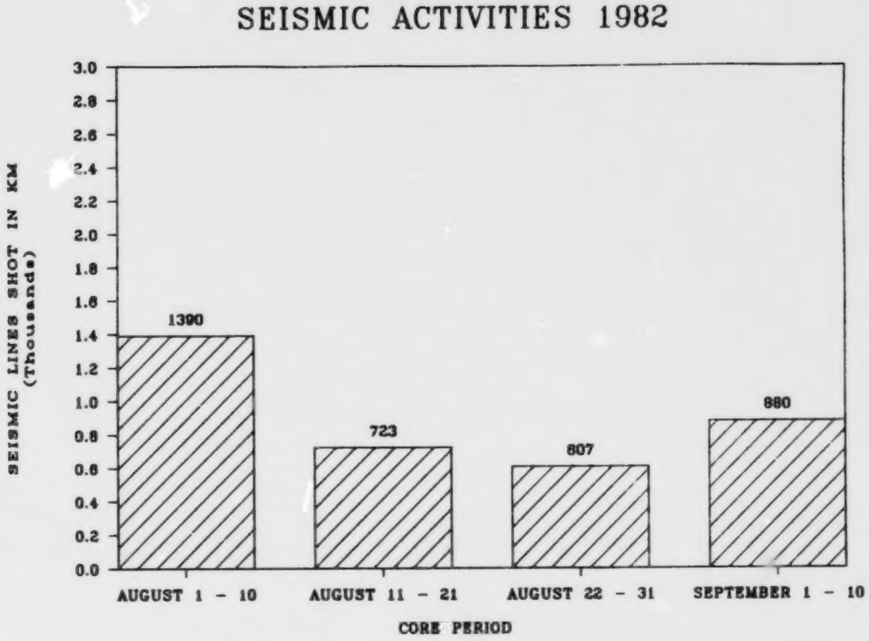
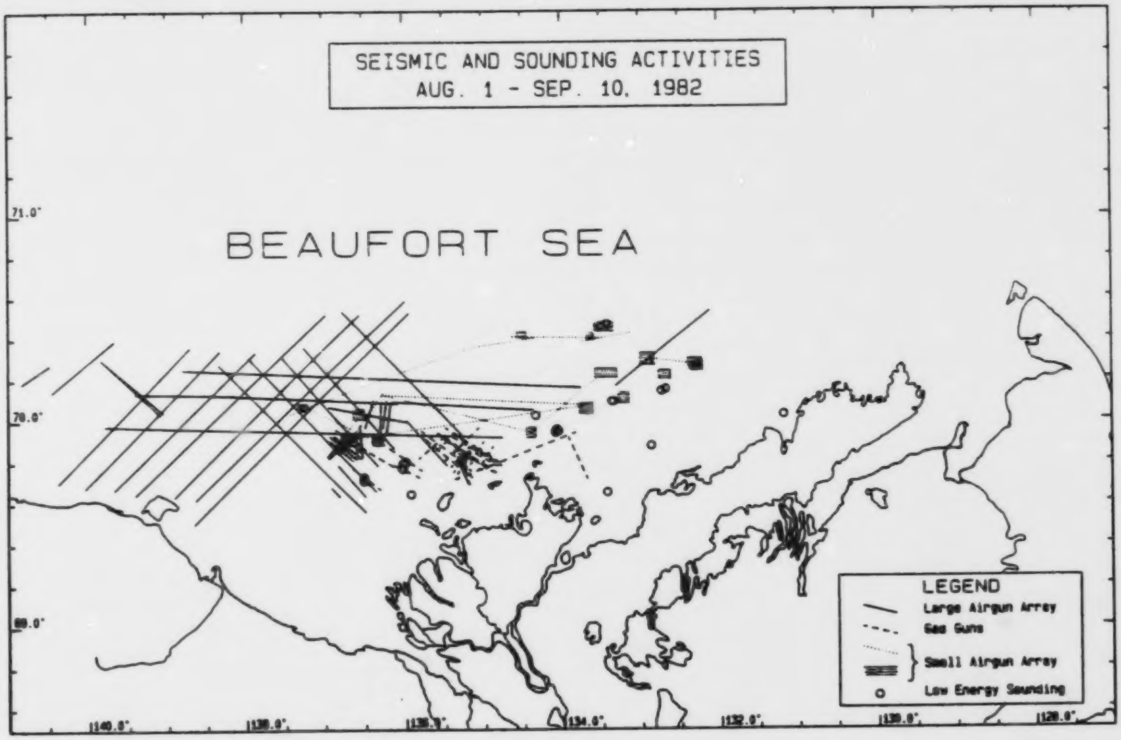


Figure 4.3-1: Seismic Activities 1982 Core Period.


SEISMIC AND SOUNDING ACTIVITIES
AUG. 1 - SEP. 10, 1982
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Gas Guns
Small Airgun Array
Low Energy Sounding

Map 4.3-2: Seismic Activities 1982 Core Period.

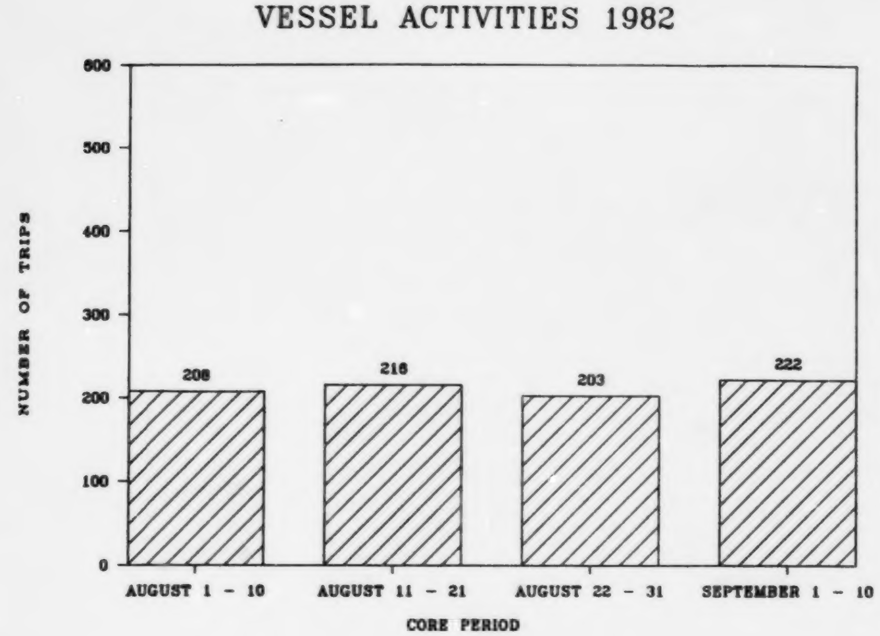
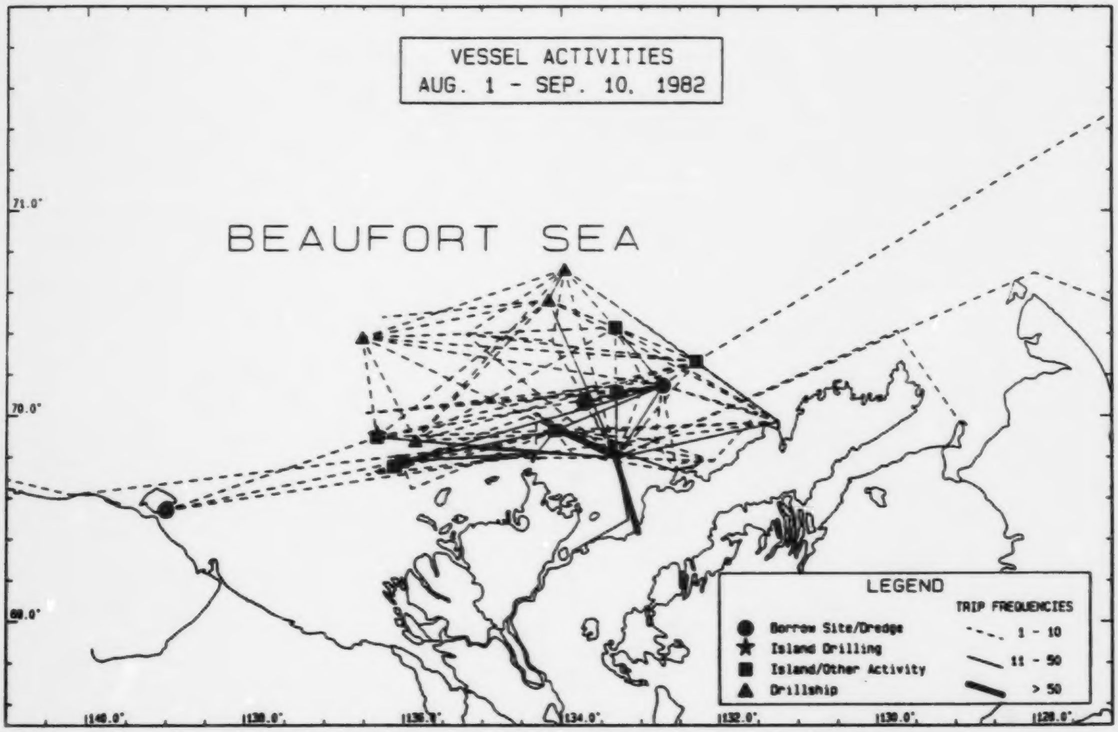


Figure 4.3-2: Vessel Activities 1982 Core Period.


VESSEL ACTIVITIES
AUG. 1 - SEP. 10, 1982
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

Map 4.3-3: Vessel Activities 1982 Core Period.

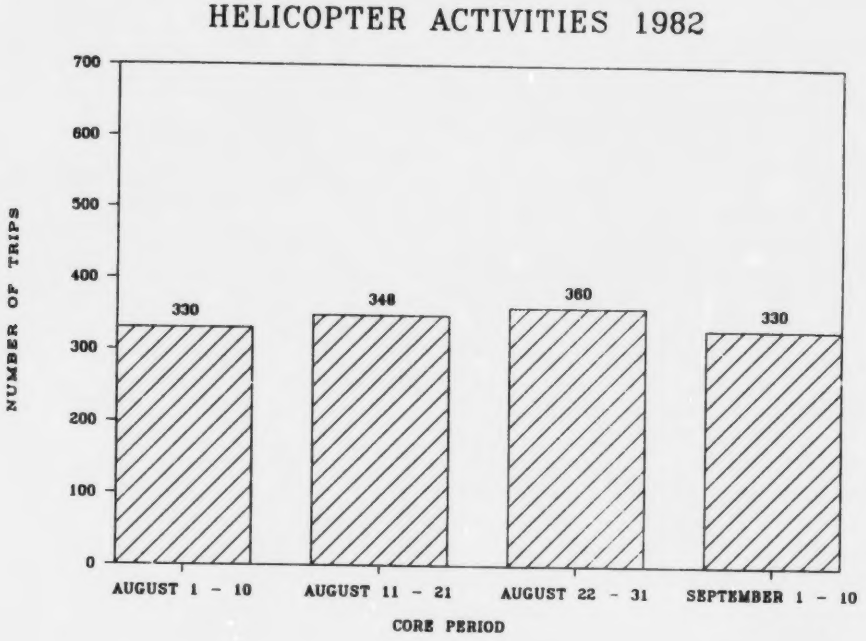
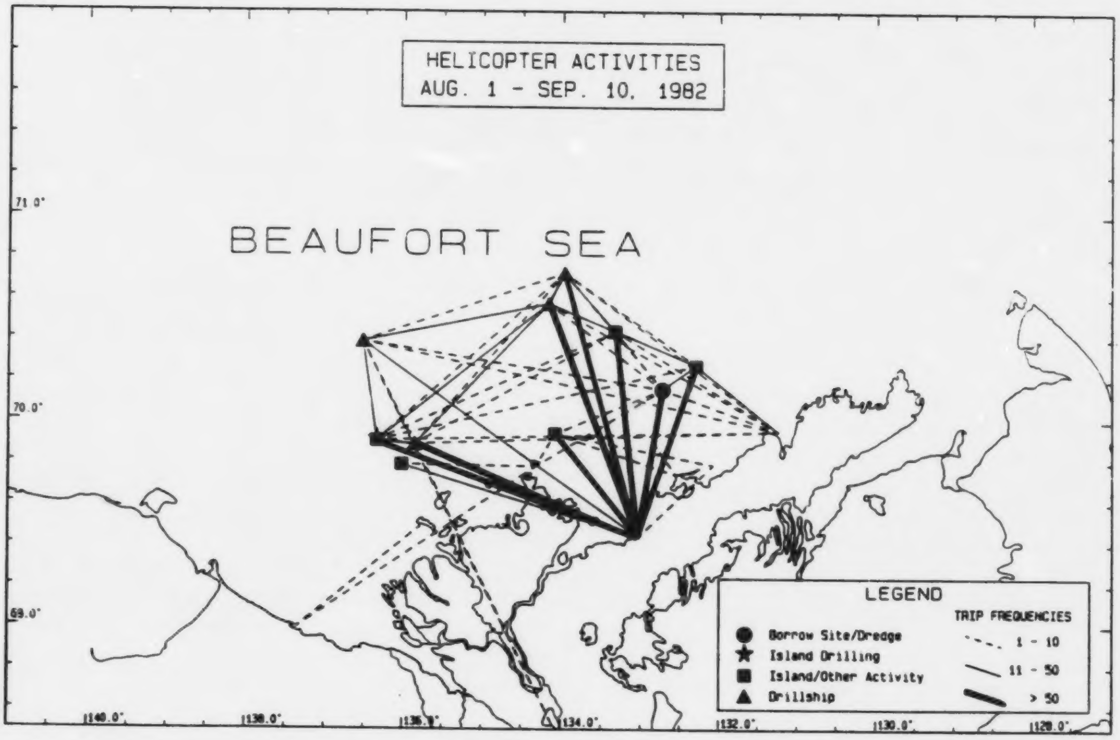


Figure 4.3-3: Helicopter Activities 1982 Core Period.


HELICOPTER ACTIVITIES
AUG. 1 - SEP. 10, 1982
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
TRIP FREQUENCIES
1 - 10
11 - 50
> 50

Map 4.3-4: Helicopter Activities 1982 Core Period.

4.4 1983 Industrial Activities

The intensity of industrial activities in the study area continued to increase in 1983. Gulf and, to a lesser extent, Esso were more active offshore. Beaudril, a Gulf subsidiary, introduced several new vessels into the Beaufort sea, including the drillship Kulluk. Dome was somewhat less active than in 1982.

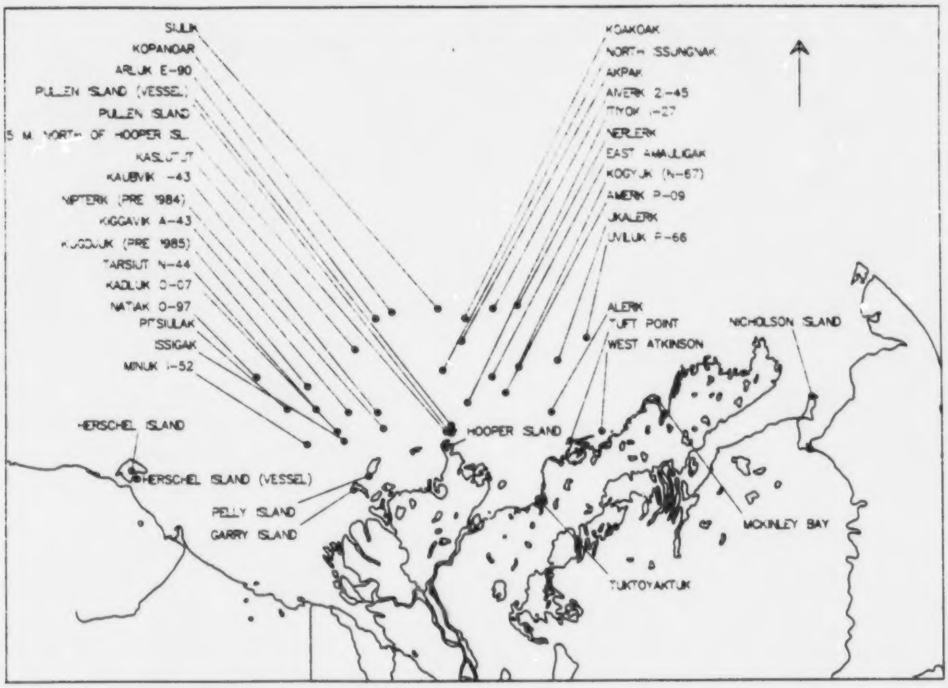
The region of most industrial activities in 1983 extended from the Natiak and Pitsiulak drillship locations north of Mackenzie Bay to McKinley Bay in the east. (See Map 4.4-1a, Map 4.4-1b). The northern periphery of the main industrial area was marked by the drillship sites Arluk and Nerlerk. Inside the industrial area, numbers of helicopter and vessel trips were greater in 1983 than in any previous year. However, there was also considerable activity outside the area of most intense activities in 1983 (especially by seismic vessels and vessels travelling to points outside the study area). In 1983, Esso made a significant oil and gas discovery at the Itiyok I-27 site. Esso commenced drilling from a steel caisson-retained island at Kadluk O-07 late in 1983. Encouraging signs of hydrocarbon potential at Gulf's Pitsiulak A-05 site were found before ice conditions forced the cessation of drilling. Drilling at Pitsiulak would resume in 1984 (COGLA, 1984).

4.4.1 Seismic and Sounding Activities

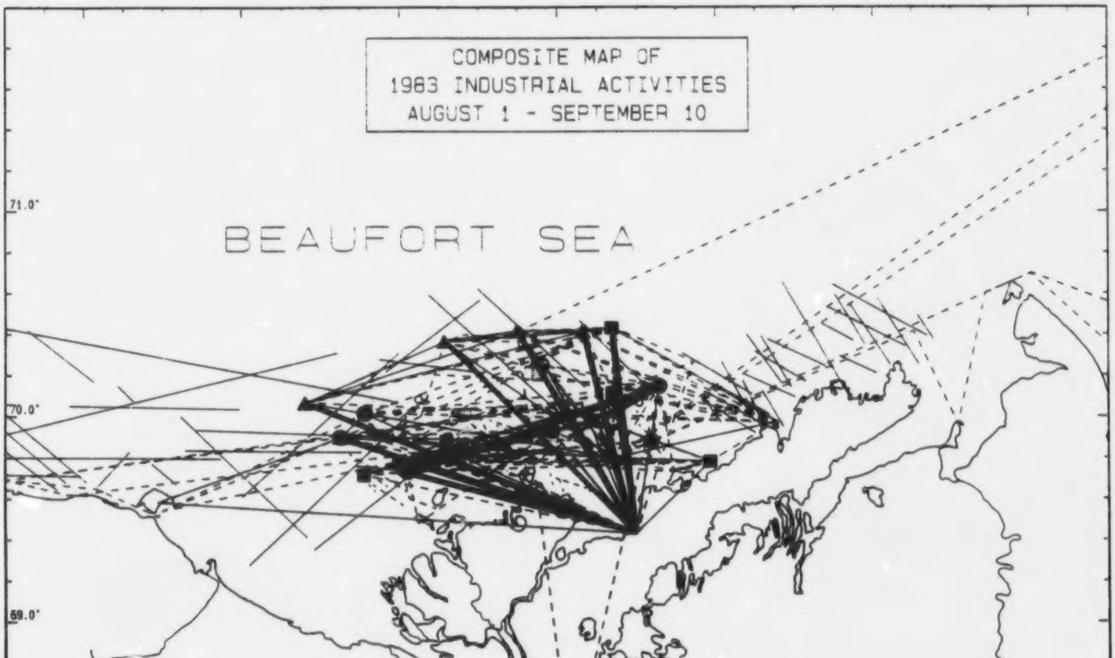
A total of five ships conducted seismic surveys in the Beaufort Sea during the 1983 Core Period. This was more than in any other year (see Figure 5.1-1). The level of 1983 seismic exploration was slightly less than in 1982: fewer than 3500 km of lines were shot between August 1 and September 10, 1983 compared with 3600 km shot during the same period in 1982 (see Figure 5.1-3). Seismic activity in 1983 was most intense in early September when more than 1600 km of lines were shot (see Figure 4.4-1).

Three vessels used large airgun arrays to conduct seismic surveys during the study period. The GSI Explorer, a new vessel used by Esso, operated in shallow water off the coast of Tuktoyaktuk Peninsula from mid August onward. The GSI Mariner and the Western Aleutian operated primarily to the west and in the Mackenzie Delta (see Map 4.4-2).

A small (320 cubic inches) array of airguns was deployed by the Canmar Teal. This vessel worked north off the coast of Richards Island until August 17. The Arctic Surveyor, using an array of gas guns, was active throughout the summer. It operated mainly in shallow water in the Mackenzie Bay and north of the Tuktoyaktuk Peninsula.


SIULIK
KOPANOAR
ARLUK E-90
PULLEN ISLAND (VESSEL)
PULLEN ISLAND
5 M. NORTH OF HOOPER ISL.
KASLUTUT
KAUBVIK I-43
NIPTERK (PRE 1984)
KIGGAVIK A-43
KUGDJUK (PRE 1985)
TARSIUT N-44
KADLUK O-07
NATIAK O-97
PITSIULAK
ISSIGAK
MINUK I-52
HERSCHEL ISLAND
HERSCHEL ISLAND (VESSEL)
PELLY ISLAND
GARRY ISLAND
HOOPER ISLAND
KOAKOAK
NORTH ISSUNGNAK
AKPAK
AMERK 2-45
ITIYOK I-27
NERLERK
EAST AMAULIGAK
KOGYUK (N-67)
AMERK P-09
UKALERK
UVILUK P-66
ALERK
TUFT POINT
WEST ATKINSON
NICHOLSON ISLAND
TUKTOYAKTUK
MCKINLEY BAY

Map 4.4-1a: 1983 Active Industrial Sites.


COMPOSITE MAP OF
1983 INDUSTRIAL ACTIVITIES
AUGUST 1 - SEPTEMBER 10
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

Map 4.4-1b: All 1983 Industrial Activities.

Four vessels conducted low-energy sounding surveys at 16 locations during the 1983 Core Period. This was less intense than in 1982 when 26 locations were surveyed. Sounding operations were limited to waters off the coast of Richards Island.

4.4.2 Site-Specific Activities

More offshore sites were active in the Canadian Beaufort Sea region in 1983 than in earlier years (see Figure 5.1-4).

All summer drilling was from drillships. The Kulluk, Gulf's new drillship, began operations at Pitsiulak in late August and continued working into September. Dome's four drilships began drilling in mid July at Natiak, Arluk, Siuluk and Aiverk. Drilling continued at these locations throughout the summer.

Dredging activities increased in 1983. Two suction dredges, four hopper dredges and two or three clamshell barges worked in the Beaufort Sea between August 1 and September 10. Dredges operated at Amerk, Kadluk, Nerlerk, Nipterk and Minuk (where artificial islands or subsea berms were under construction), and at Issigak, Kaubvik, Kogyuk, Kugdjuk and Ukalerk. Construction of Esso's first caisson-retained island, at Kadluk, was completed in 1983.

4.4.3 Vessel Activities

Vessel activities increased significantly in 1983 over previous years. Over 1400 trips were recorded during the 1983 Core Period compared with fewer than 900 in 1982 and fewer than 1000 in 1981 (see Figure 5.1-8). Vessel traffic increased steadily from August 1 to September 10, 1983 and reached a peak in early September (see Figure 4.4-2).

Vessel traffic in support of drilling and island construction activities extended from Natiak in the west to McKinley Bay in the east. There was also some traffic in support of dredging operations farther west to Gulf's barge camp at Herschel Island, and farther northeast to Banks Island. A few trips were also made to points east and west of the study area in support of DEW sites and communities (see Map 4.4-3).

4.4.4 Helicopter Activities

Helicopter traffic was about 13% greater in 1983 than in 1982. A total of 10 twin-turbine engine helicopters operated offshore in 1983 -- more than in any year before. Helicopter activities in 1983 increased towards the end of August (see Figure 4.4-3), but remained relatively stable during the remainder of the Core Period.

The general pattern of helicopter movements was similar to that of the vessel movements. Most helicopter traffic was between Tuktoyaktuk, McKinley Bay and various offshore sites. Some helicopter traffic extended as far west as Herschel Island and as far east as McKinley Bay (see Map 4.4-4).

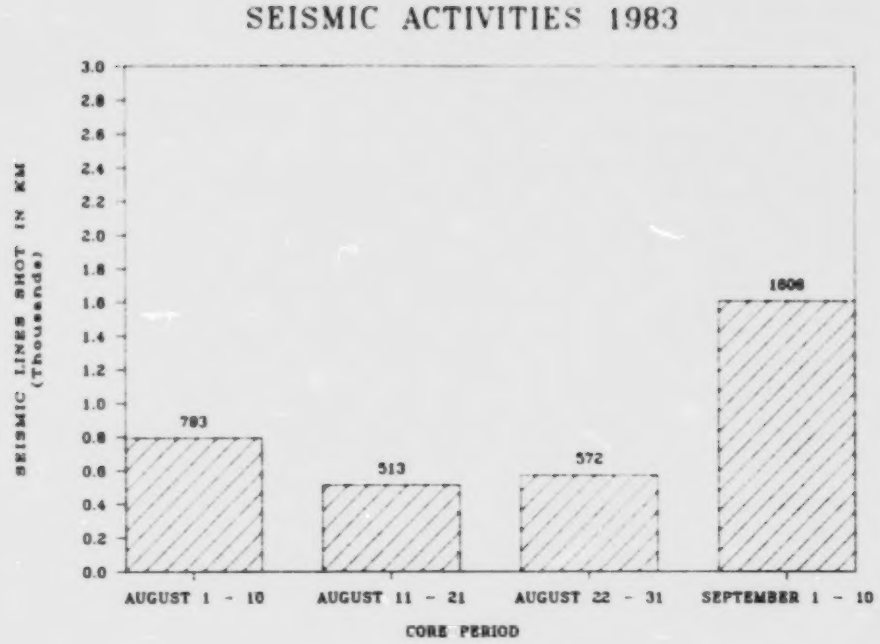
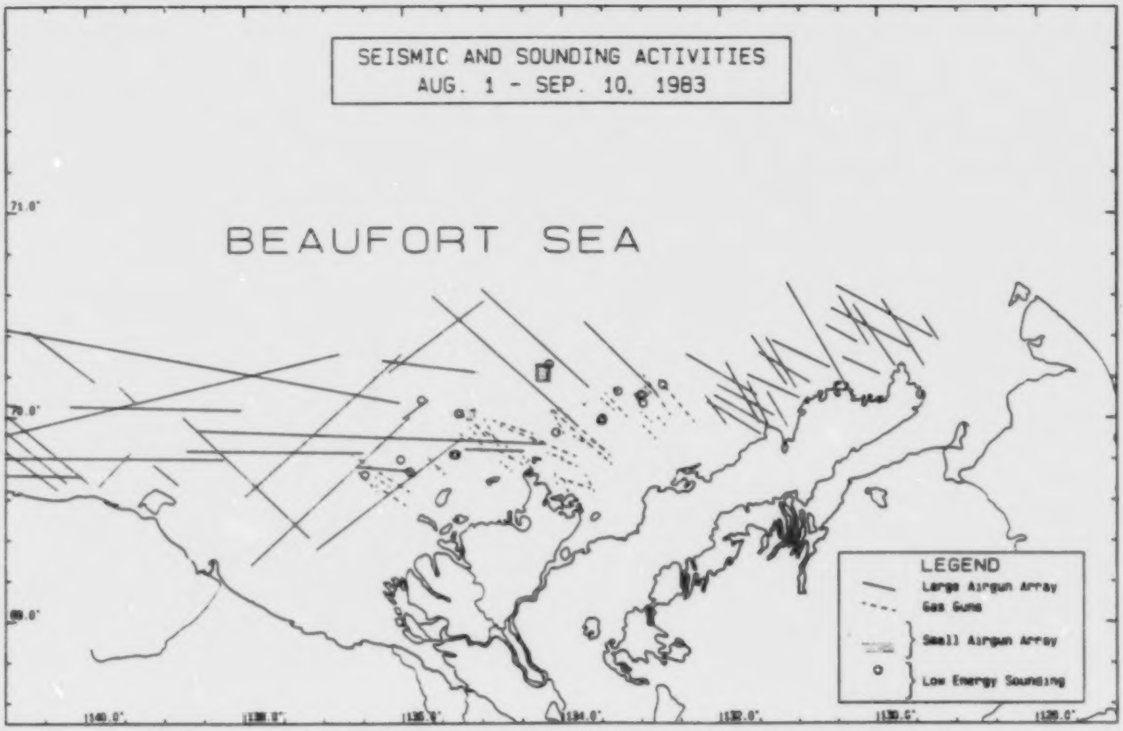


Figure 4.4-1: Seismic Activities 1983 Core Period.


SEISMIC AND SOUNDING ACTIVITIES
AUG. 1 - SEP. 10, 1983
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Gas Guns
Small Airgun Array
Low Energy Sounding

Map 4.4-2: Seismic Activities 1983 Core Period.

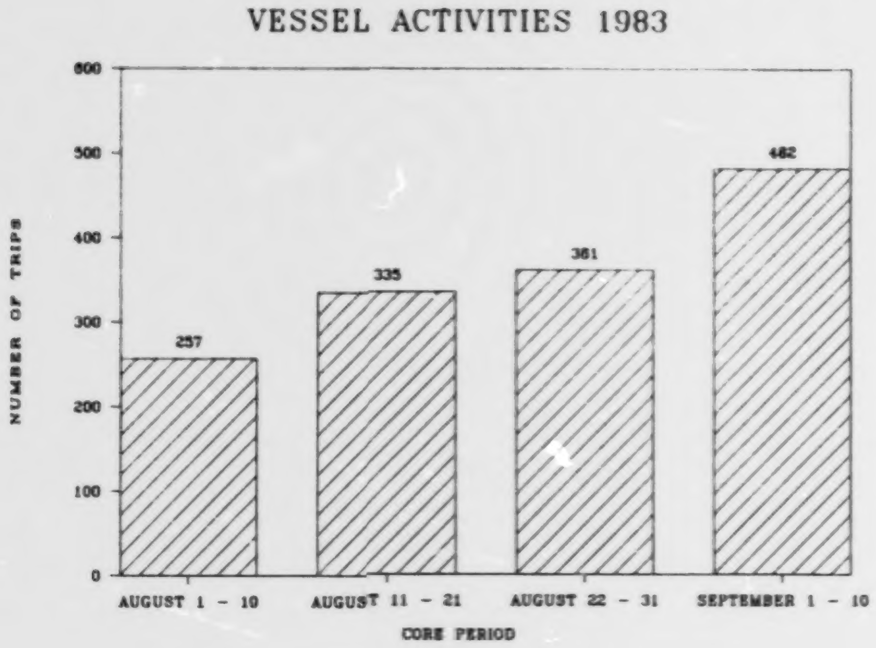
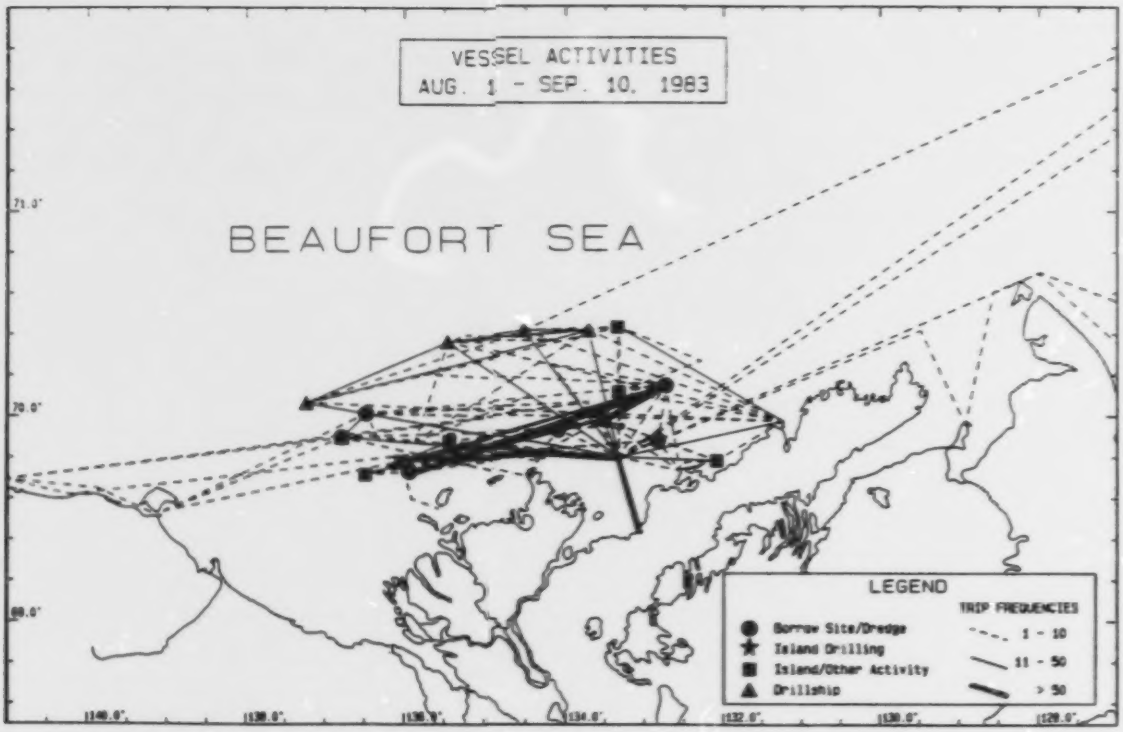


Figure 4.4-2: Vessel Activities 1983 Core Period.


VESSEL ACTIVITIES
AUG. 1 - SEP. 10, 1983
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

Map 4.4-3: Vessel Activities 1983 Core Period.

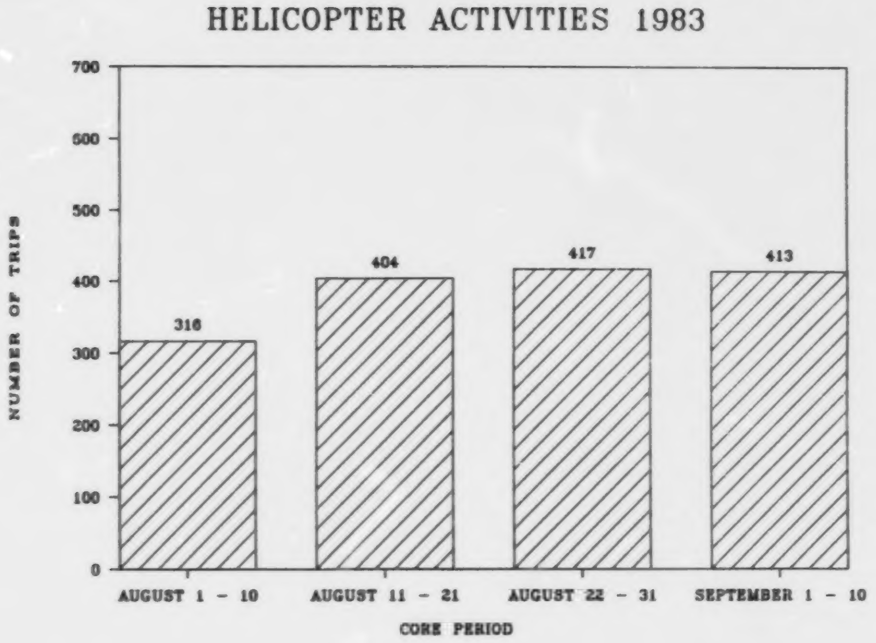
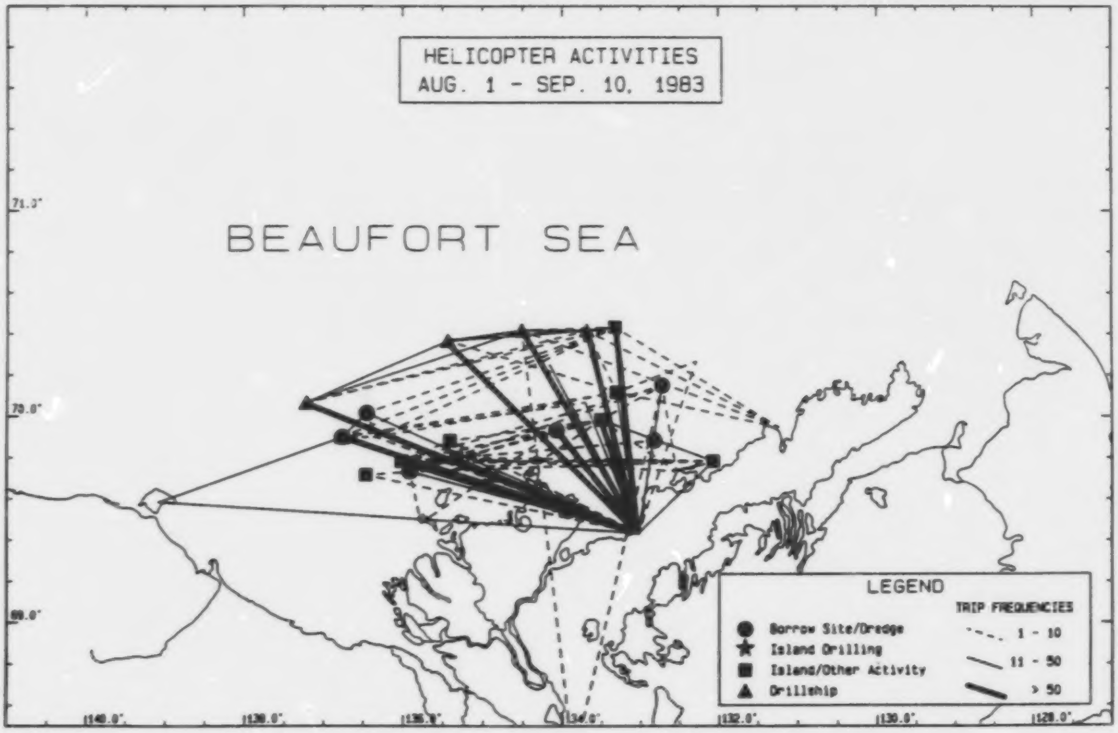


Figure 4.4-3: Helicopter Activities 1983 Core Period.


HELICOPTER ACTIVITIES
AUG. 1 - SEP. 10, 1983
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
TRIP FREQUENCIES
1 - 10
11 - 50
> 50

Map 4.4-4: Helicopter Activities 1983 Core Period.

4.5 1984 Industrial Activities

The level of industrial activities in the Canadian Beaufort Sea was higher in 1984 than in any other between 1980 and 1986. Dome, Esso, and Gulf were active offshore. Gulf resumed drilling at Pitsiulak A-05, and an oil discovery was also made at Gulf's Amauligak J-44 site. This discovery was delineated in 1985. Gas was discovered in the Kadluk O-07 well.

The region with greatest industrial activities changed little from 1983 to 1984 (see Maps 4.4-1a,b and 4.5-1a,b). The most significant change was a westward extension in 1984 because of increased traffic to and from Herschel Island. The outer boundary of the main industrial area in 1984 was defined by the Dome drillship sites at Natiak, Arluk, Siulik, Aiverk, and Havik, and extended east to McKinley Bay.

4.5.1 Seismic and Sounding Activities

In comparison to 1983, more seismic lines were recorded in 1984 (168 versus 92 -- see Figure 5.1-2). In 1984, however, the actual number of kilometres of seismic line shot was less. Seismic exploration was most active in mid August (see Figure 4.5-1). Additional information on seismic activities before and after the Core Period was also logged (see maps Appendix B).

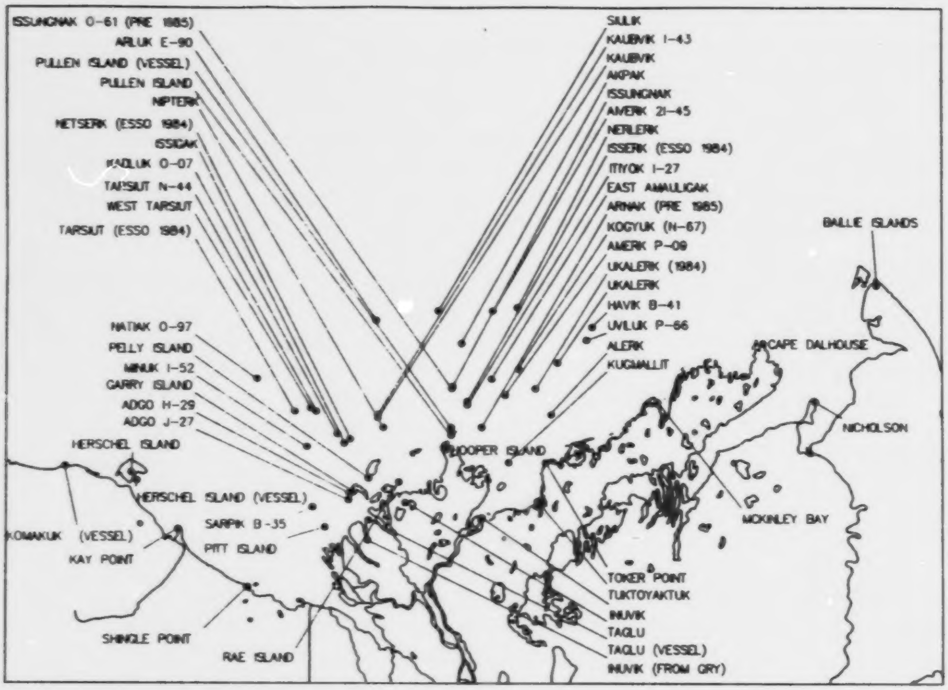
Four vessels conducted seismic surveys in 1984. Three of these, the GSI Explorer, the E.O. Vetter, and the GSI Mariner used large airgun arrays. These vessels operated west to the Alaska border and as far east as Cape Bathurst.

The Arctic Surveyor deployed an array of gas guns in the areas where Esso has leases. This vessel was much less mobile than the vessels equipped with large airgun arrays in part because it stopped each time a series of shots was fired. The Arctic Surveyor operated in shallow water off the coast of Richards Island until mid September; thereafter it shot lines off western Tuktoyaktuk Peninsula (see Map 4.5-2).

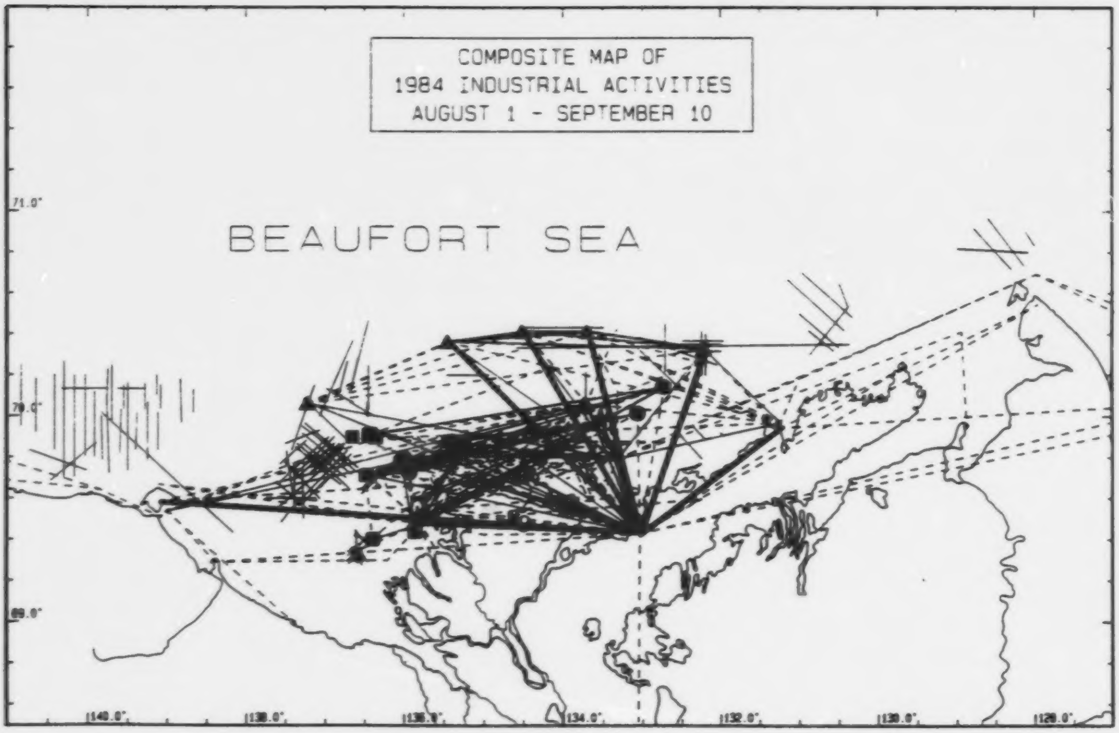
Sounding activity information was not available for 1984.

4.5.2 Site-Specific Activities

Dome operated four drillships in 1984. Three of these were at specific sites (Arluk, Siulik, and Havik) during the entire Core Period. The fourth drillship was at the Aiverk drillsite until the end of August. It then moved to Natiak. Gulf's circular drillship was stationed at East Amauligak throughout the Core Period. In late August, drilling began at the Amerk caisson-retained island. Four hopper dredges and three clamshell barges constructed six islands or sub-sea berms in 1984.


ISSUNGNAK O-61 (PRE 1985)
ARLUK E-90
PULLEN ISLAND (VESSEL)
PULLEN ISLAND
NIPTERK
NETSERK (ESSO 1984)
ISSIGAK
KADLUK O-07
TARSIUT N-44
WEST TARSIUT
TARSIUT (ESSO 1984)
NATIAK O-97
PELLY ISLAND
MINUK I-52
GARRY ISLAND
ADGO H-29
ADGO J-27
HERSCHEL ISLAND
HERSCHEL ISLAND (VESSEL)
SARPIK B-35
PITT ISLAND
KOMAKUK (VESSEL)
KAY POINT
SHINGLE POINT
RAE ISLAND
SIULIK
KAUBVIK I-43
KAUBVIK
AKPAK
ISSUNGNAK
AMERK 2I-45
NERLERK
ISSERK (ESSO 1984)
ITIYOK I-27
EAST AMAULIGAK
ARNAK (PRE 1985)
KOGYUK (N-67)
AMERK P-09
UKALERK (1984)
UKALERK
HAVIK B-41
UVLUK P-66
ALERK
KUGMALLIT
HOOPER ISLAND
CAPE DALHOUSE
BAILLIE ISLANDS
NICHOLSON
MCKINLEY BAY
TOKER POINT
TUKTOYAKTUK
INUVIK
TAGLU
TAGLU (VESSEL)
INUVIK (FROM GRY)

Map 4.5-1a: 1984 Active Industrial Sites.


COMPOSITE MAP OF
1984 INDUSTRIAL ACTIVITIES
AUGUST 1 - SEPTEMBER 10
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

Map 4.5-1b: All 1984 Industrial Activities.

4.5.3 Vessel Activities

Over 1600 vessel trips were recorded in 1984 between August 1 and September 10, compared with fewer than 1450 for 1983, the second most active year (see Figure 5.1-8). Vessel traffic was most frequent in mid August (see Figure 4.5-2).

The areal extent of vessel movements was also greater than in 1983 (see maps 4.4-3 and 4.5-3). Gulf's camp at Herschel Island was the westernmost of the common destinations, while Dome's camp at McKinley Bay was the easternmost. There were some additional trips to points east and west of this area during the Core Period, but it is not known exactly when these trips occurred.

4.5.4 Helicopter Activities

Although fewer helicopters operated offshore during the 1984 Core Period than in 1983, a total of almost 1800 helicopter movements were logged between August 1 and September 10 -- more than in any previous year. Helicopter activity was most intense during early August and declined in September (see Figure 4.5-3). The majority of helicopter movements were between Tuktoyaktuk and the offshore industrial sites. Frequent helicopter trips were also made from McKinley Bay and Herschel Island (see Map 4.5-4).

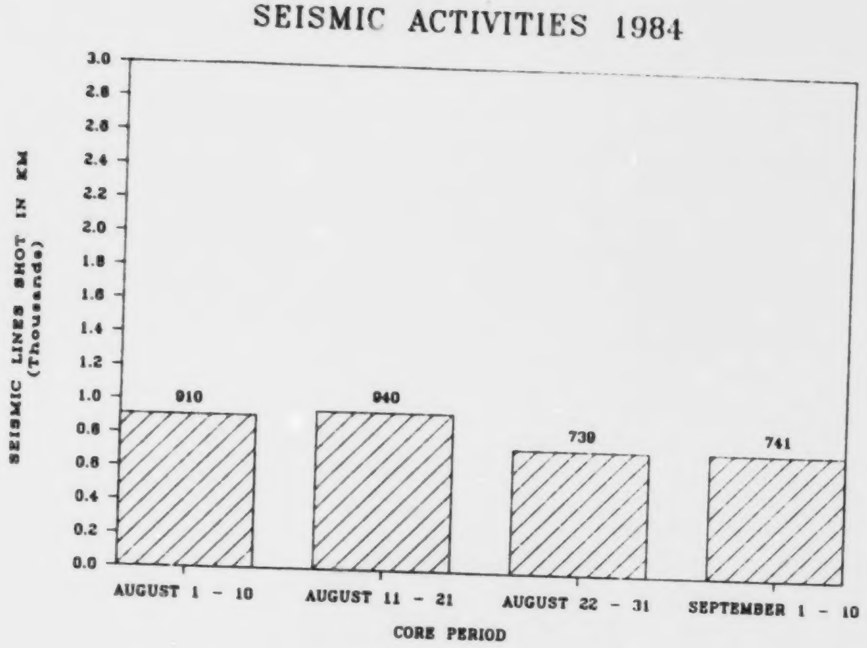
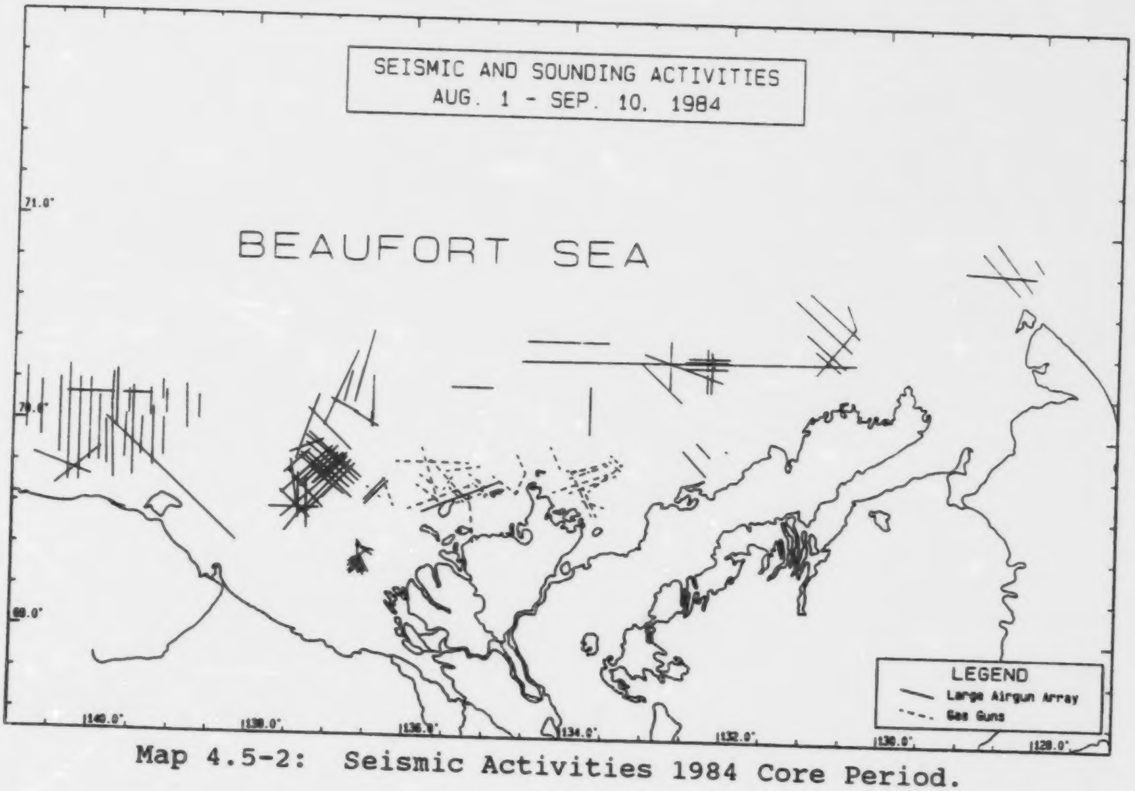


Figure 4.5-1: Seismic Activities 1984 Core Period.


SEISMIC AND SOUNDING ACTIVITIES
AUG. 1 - SEP. 10, 1984
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Gas Guns

Map 4.5-2: Seismic Activities 1984 Core Period.

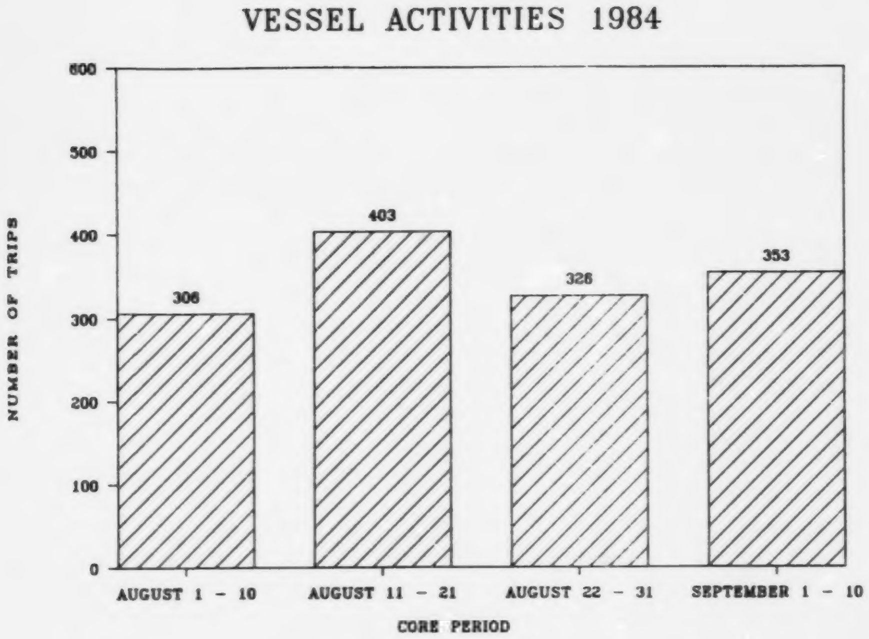
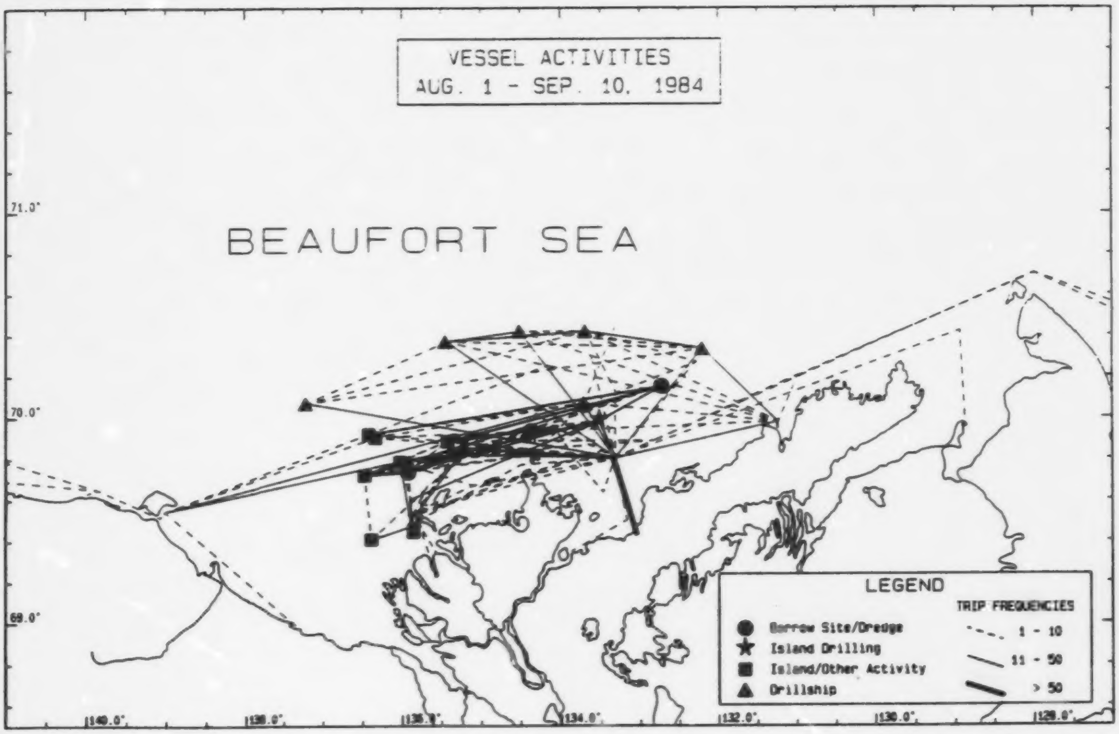


Figure 4.5-2: Vessel Activities 1984 Core Period.


VESSEL ACTIVITIES
AUG. 1 - SEP. 10, 1984
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

Map 4.5-3: Vessel Activities 1984 Core Period.

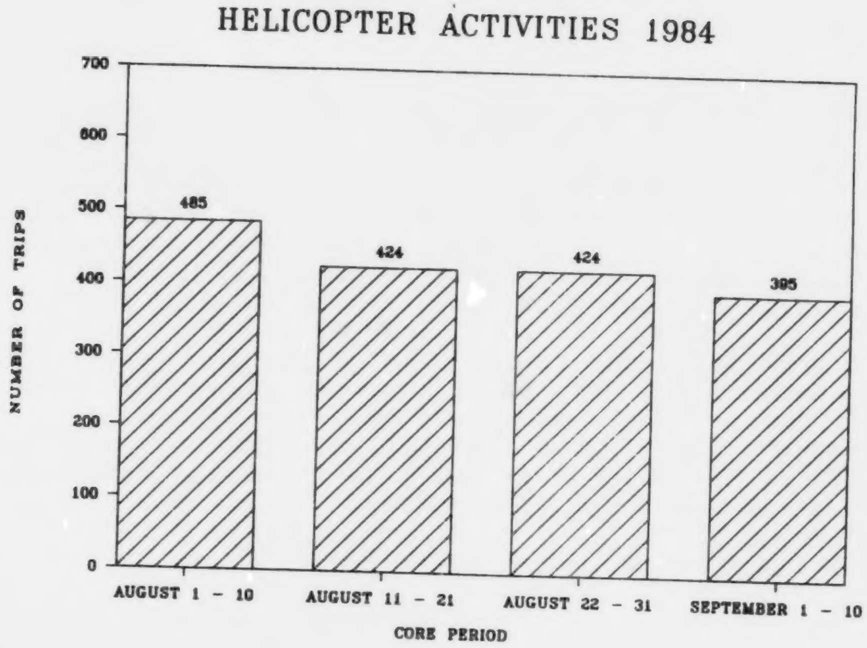
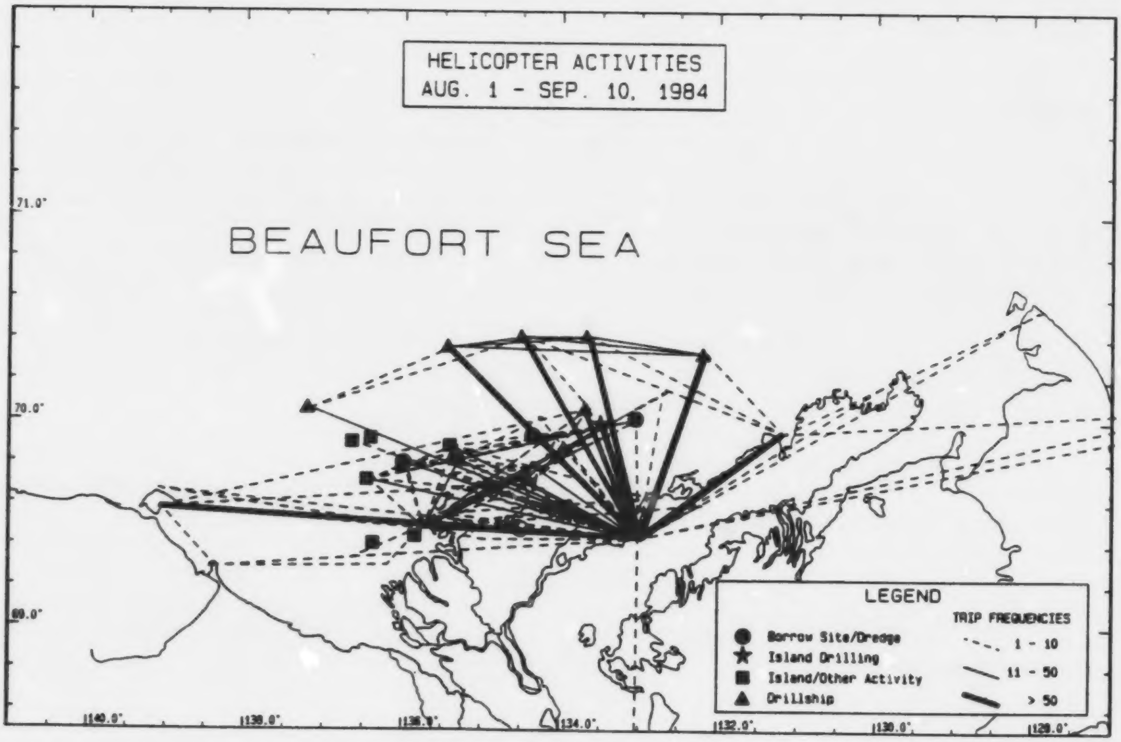


Figure 4.5-3: Helicopter Activities 1984 Core Period.


HELICOPTER ACTIVITIES
AUG. 1 - SEP. 10, 1984
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

Map 4.5-4: Helicopter Activities 1984 Core Period.

4.6 1985 Industrial Activities

Three oil companies (Dome, Esso, and Gulf) were active in the Beaufort Sea region during the time period June 01 - December 31, 1985. The level of industrial activities during the Core Period was relatively high in 1985, although less than in 1984. Discoveries were made at three sites: gas was found at Esso's Amerk O-09 well, oil and gas were discovered at Esso's Nipterk L-19 well, and oil was discovered at Dome's Adlartok P-09 well in an area where there had been little previous drilling. Oil also flowed at Gulf's Amauligak I-65 delineation well (COGLA, 1986).

The eastern boundary for most of the industrial activities in 1985 was McKinley Bay, as it had been since 1980 (see Map 4.6-1a, b). However, the western boundary of the industrial area was much farther west in 1985 than it had been in any other year since 1979. This was due to extensive activity near Gulf's barge camp and drillship activities at Edlok, west of Herschel Island.

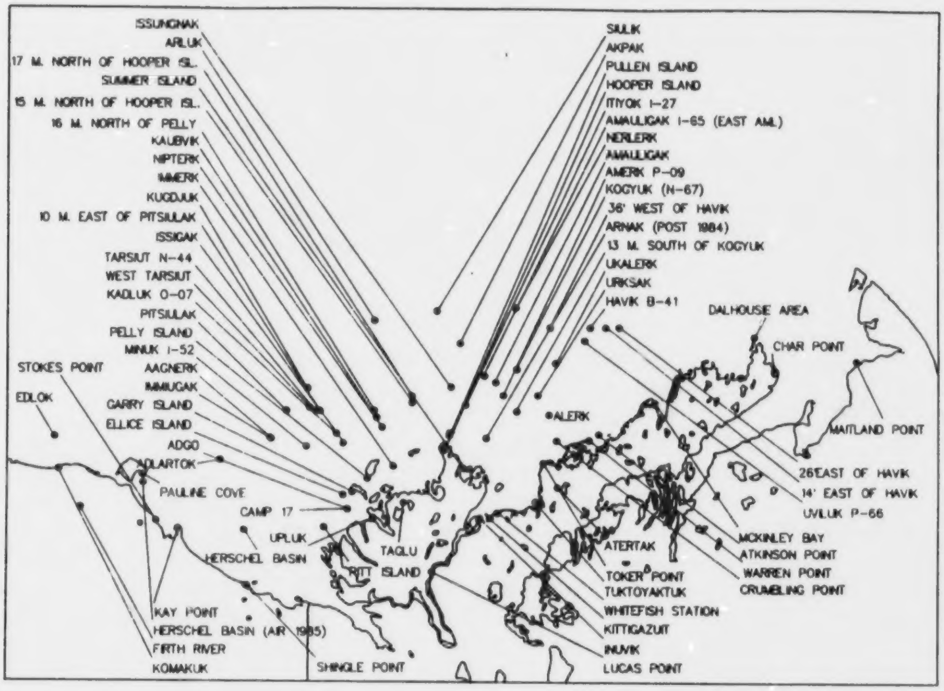
4.6.1 Seismic and Sounding Activities

Five vessels, the Arctic Surveyor, the GSI Explorer, the Frank Broderick, the Arctic Kiggiak, and the Western Anchorage, conducted seismic or sounding surveys in the study area in 1985. More seismic activity was recorded for the early September period (540 km of seismic line shot -- see Figure 4.6-1) than for any other 10-day period that year.

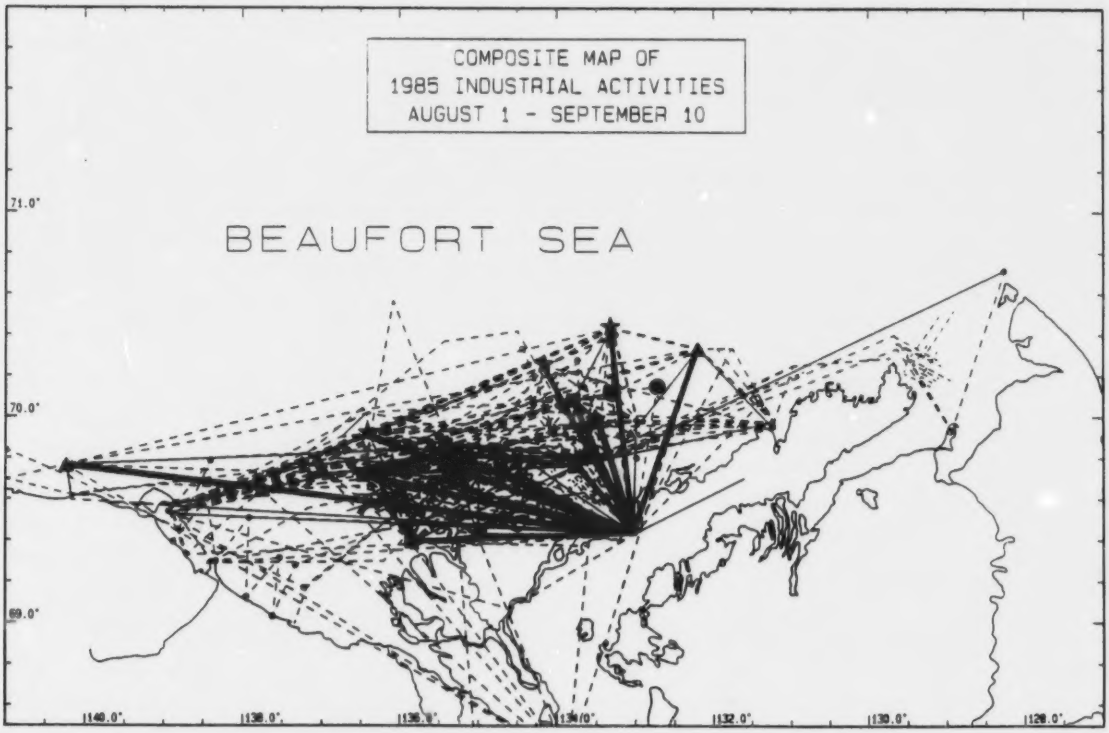
The first seismic line shot in 1985 was shot in early August in the Mackenzie Delta. Seismic lines were shot using large airgun arrays or open-bottom gas guns. Vessels using large airgun arrays worked in shallow water in the Mackenzie Delta. Vessels using gas guns operated over a more extensive area in 1985: lines were shot as far west as Mackenzie Bay in early August and as far east as Cape Dalhousie in early and mid September (see Map 4.6-2).

Detailed information on only one sounding survey, the first of the year, was available for 1985. It occurred at the Arnak site in Kugmallit Bay from July 22 to July 26.

Some additional seismic and sounding activities were conducted in 1985, but details were incomplete: the Western Anchorage conducted surveys in the westernmost part of the study area from August 31 through September 10, 1985; information on some lines shot by the GSI Explorer was not available; shallow seismic lines shot at Adlartok and Immiugak by the Arctic Kiggiak were not recorded because survey dates were not available (Norton and McDonald 1986).


ISSUNGNAK
ARLUK
17 M. NORTH OF HOOPER ISL.
SUMMER ISLAND
15 M. NORTH OF HOOPER ISL.
16 M. NORTH OF PELLY
KAUBVIK
NIPTERK
IMMERK
KUGDJUK
10 M. EAST OF PITSIULAK
ISSIGAK
TARSIUT N-44
WEST TARSIUT
KADLUK O-07
PITSIULAK
PELLY ISLAND
MINUK I-52
STOKES POINT
AAGNERK
IMMIUGAK
EDLOK
GARRY ISLAND
ELLICE ISLAND
ADGO
ADLARTOK
PAULINE COVE
CAMP 17
UPLUK
HERSCHEL BASIN
TAGLU
PITT ISLAND
KAY POINT
HERSCHEL BASIN (AIR 1985)
FIRTH RIVER
KOMAKUK
SHINGLE POINT
SIULIK
AKPAK
PULLEN ISLAND
HOOPER ISLAND
ITIYOK I-27
AMAULIGAK I-65 (EAST AML)
NERLERK
AMAULIGAK
AMERK P-09
KOGYUK (N-67)
36' WEST OF HAVIK
ARNAK (POST 1984)
13 M. SOUTH OF KOGYUK
UKALERK
URKSAK
HAVIK B-41
DALHOUSIE AREA
CHAR POINT
ALERK
MAITLAND POINT
26'EAST OF HAVIK
14' EAST OF HAVIK
UVILUK P-66
MCKINLEY BAY
ATKINSON POINT
WARREN POINT
CRUMBLING POINT
ATERTAK
TOKER POINT
TUKTOYAKTUK
WHITEFISH STATION
KITTIGAZUIT
INUVIK
LUCAS POINT

Map 4.6-1a: 1985 Active Industrial Sites.


COMPOSITE MAP OF
1985 INDUSTRIAL ACTIVITIES
AUGUST 1 - SEPTEMBER 10
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

Map 4.6-1b: All 1985 Industrial Activities.

4.6.2 Site-Specific Activities

In 1985, three drillships operated at four locations in the Canadian Beaufort Sea. The Explorer II was in the Alaskan Beaufort. Drillships were active from August 3 to October 18. A drillship worked at Adlartok from early August until October. Drilling occurred at Edlok from early August until mid September, after which the drillship moved to commence work at Arluk. The third drillship started drilling near the end of August at Havik and ended activities there in October.

Drilling from islands and from mobile drilling platforms on sub-sea berms occurred throughout the period June 01 - December 31, 1985. Except for Kaubvik, drilling occurred at all locations where islands or berms were constructed in 1985. Drilling also occurred at Akpak, Amerk, Nerlerk, Nipterk, Taglu and West Tarsiut. Eight dredges (four trailing suction hopper, three clamshell bucket and one cutter suction) used ten borrow sites in 1985 to construct or rebuild five islands (Adgo, Arnak, Kaubvik, North Ellice and Minuk) and two berms (Aagnerk and Amauligak). Three glory holes were also dredged. Dredging started in mid July and continued through October.

4.6.3 Vessel Activities

In 1985, at least 71 vessels operated in the study area (Norton and McDonald 1986) including those making nearshore trips (i.e. in water depths < 10 m). However, fewer actual vessel trips were recorded during the August 1 to September 10 Core Period in 1985 than in 1984: 1124 versus 1626 respectively (see Figure 5.1-8). During 1985, the level of vessel activity increased from June through September and then declined from September through December (see Figure 5.2-3). More vessel trips were made during the late September period than during any other 10-day period that year. Within the Core Period, most vessel activity was recorded between August 22 and August 31 (see Figure 4.6-2).

In June and early July, most vessel movements were associated with attempts to reach offshore locations where ice had forced some vessels to change locations. During the period late July to October, most vessel movements were associated with dredges, although supply runs to offshore sites were also common. Most dredge movements were short (less than 20 km). In late October and November, many of the vessel movements were associated with the return of employees, equipment and supplies from offshore sites to Tuktoyaktuk in preparation for winter.

The geographic extent of vessel traffic during the 1985 Core Period was greater than in previous years. Vessel trips in support of drillship activities at Edlok (off the coast near the Alaska-Yukon border) were frequent, and vessels regularly travelled as far east as Ballie Island (see Map 4.6-3).

During June and July, the locations of most vessel activity were either within or just north of the Mackenzie estuary; the prevailing ice conditions prohibited movements farther north or east. However, some of these areas opened to vessel movements in August. In November and December, most vessel activity was concentrated in the west, around Herschel Island.

4.6.4 Helicopter Activities

A total of 11 helicopters supported the 1985 oil and gas exploration. Helicopter activities were more intense during the 1985 Core Period than in any earlier year; there were a total of 2220 helicopter flights compared with 1781 for 1984, the second most active year (see Figure 5.1-10). The frequency of helicopter flights changed little from mid August to mid September (see Figure 4.6-3), and declined thereafter. The most frequent trips were between Tuktoyaktuk and the various island drilling locations (see Map 4.6-4). From August to October, there were many flights between Tuktoyaktuk and the various construction locations. In November, there was an increase in the number of flights between drilling sites and over-wintering sites.

The geographic area within which most helicopter flights occurred in 1985 remained relatively constant and was somewhat smaller during the Core Period as compared to 1984. The east-west extent was from west of Herschel Island to McKinley Bay. In July and December, there were a few flights farther east. In August, September and October, some flights extended to more northerly locations as the ice receded and vessels were able to reach more northerly locations. No helicopters flew farther west than Herschel Island in November and December.

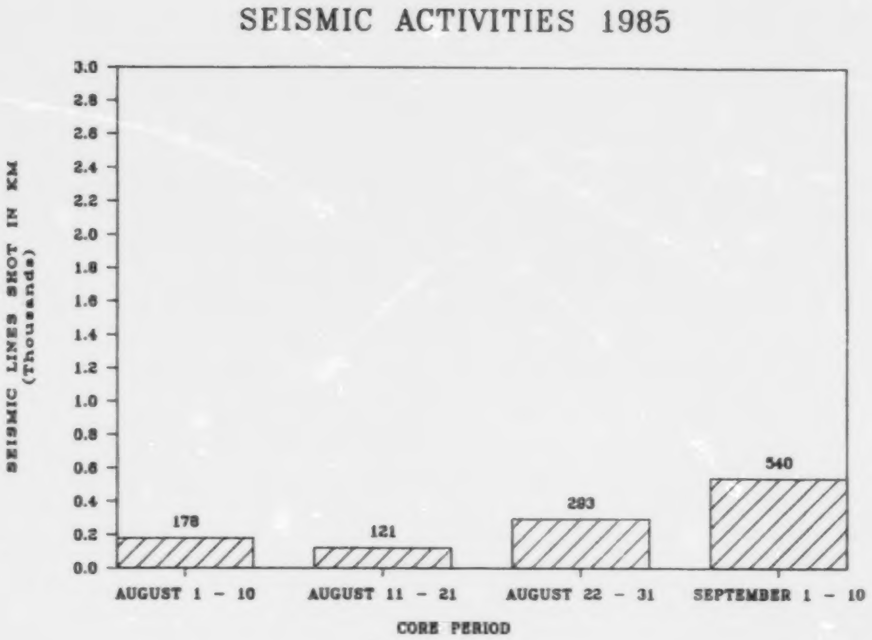
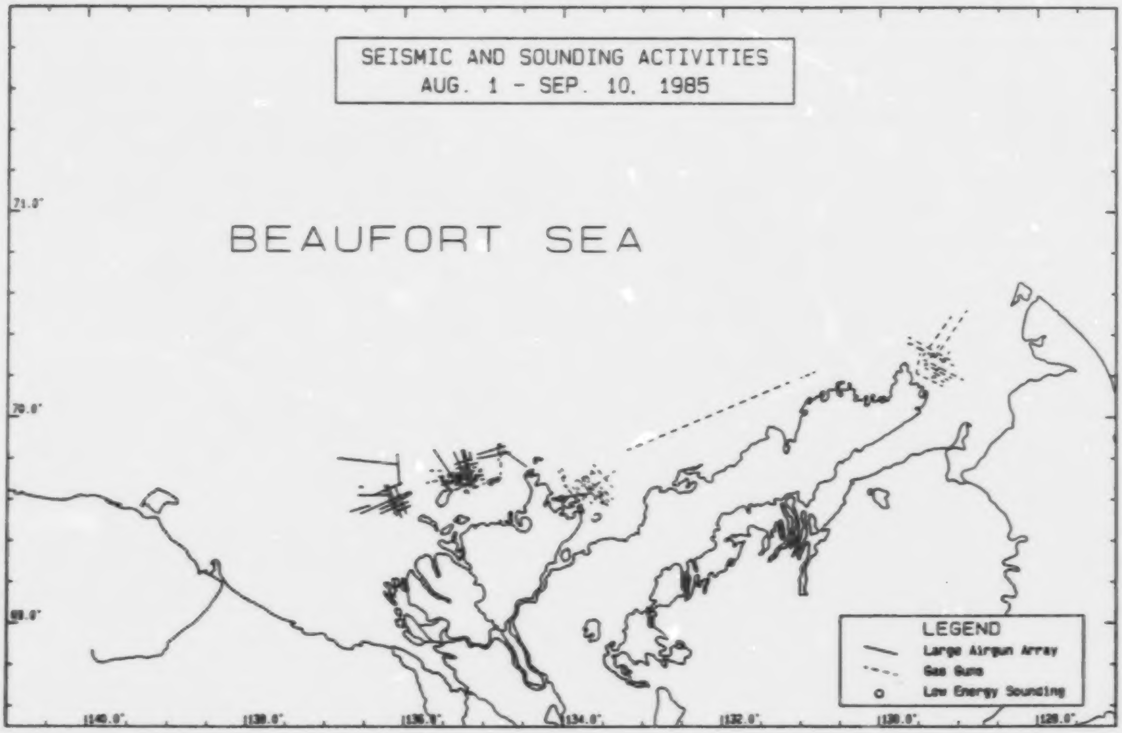


Figure 4.6-1: Seismic Activities 1985 Core Period.


SEISMIC AND SOUNDING ACTIVITIES
AUG. 1 - SEP. 10, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Gas Guns
Low Energy Sounding

Map 4.6.2: Seismic Activities 1985 Core Period.

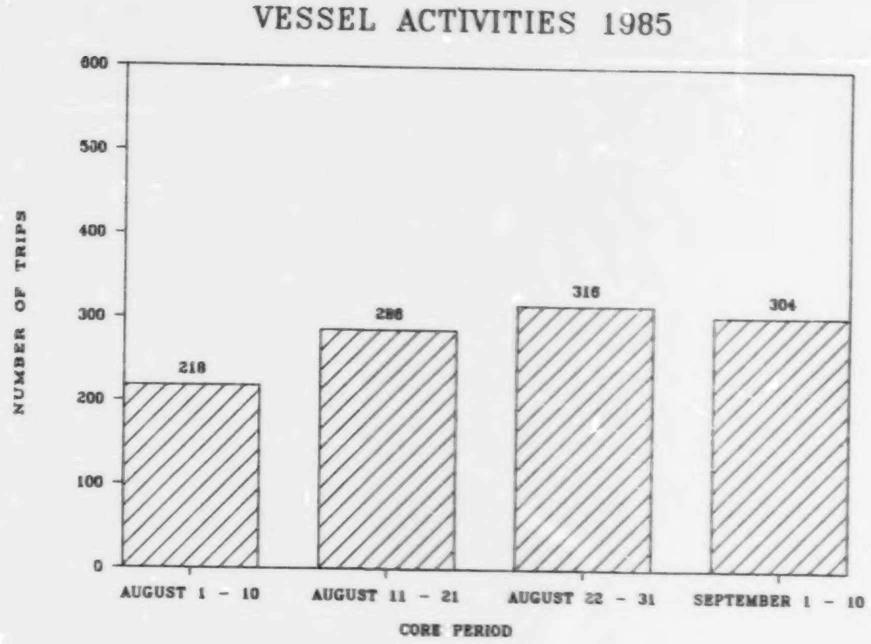
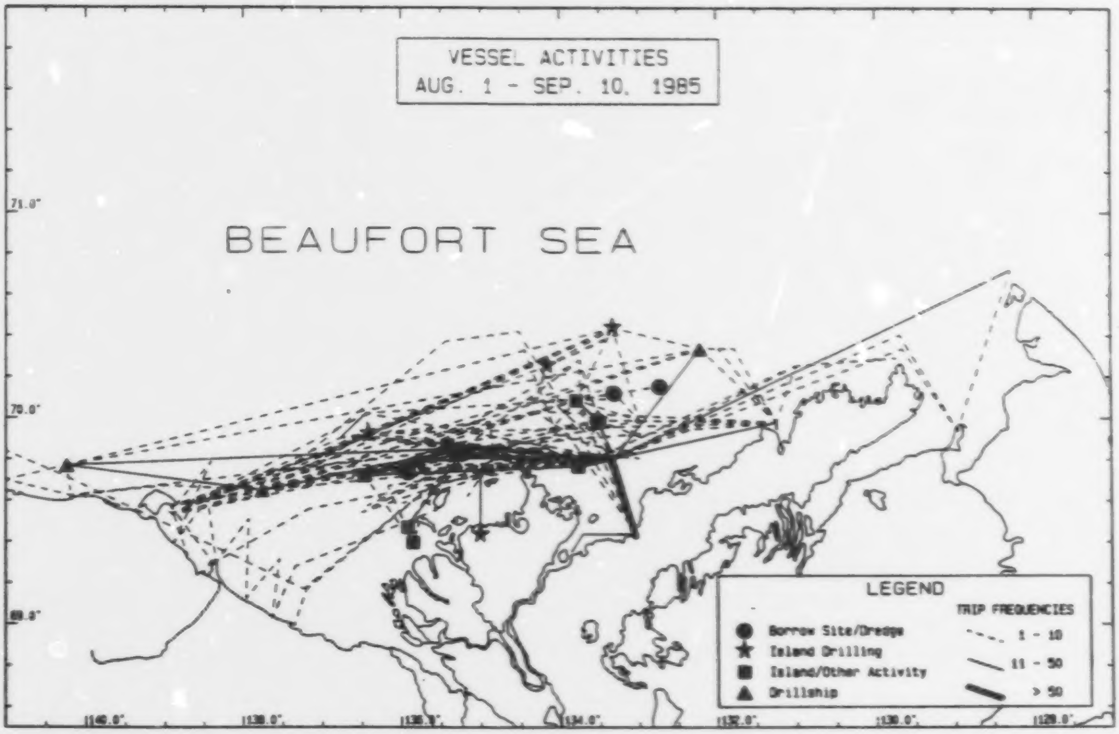


Figure 4.6-2: Vessel Activities 1985 Core Period.


VESSEL ACTIVITIES
AUG. 1 - SEP. 10, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

Map 4.6-3: Vessel Activities 1985 Core Period.

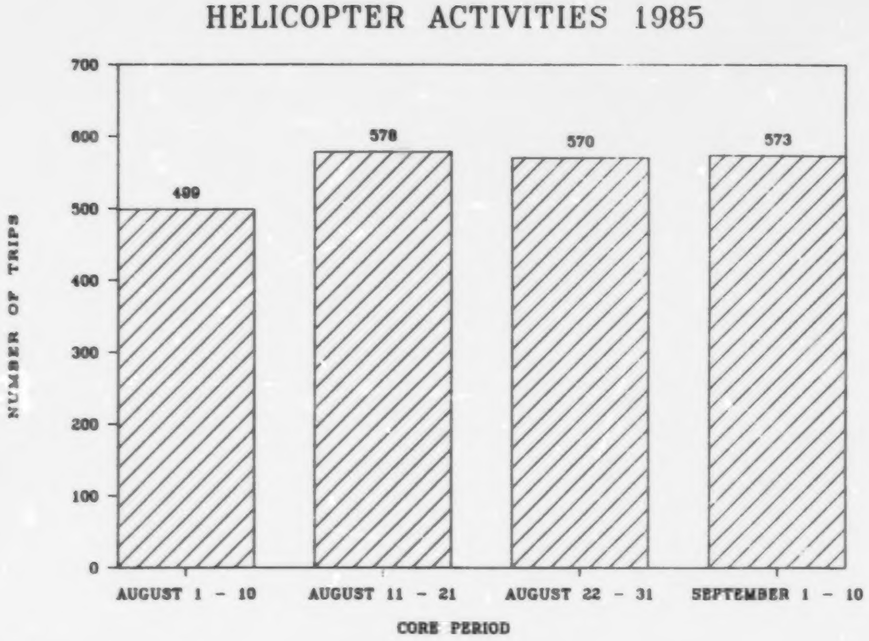
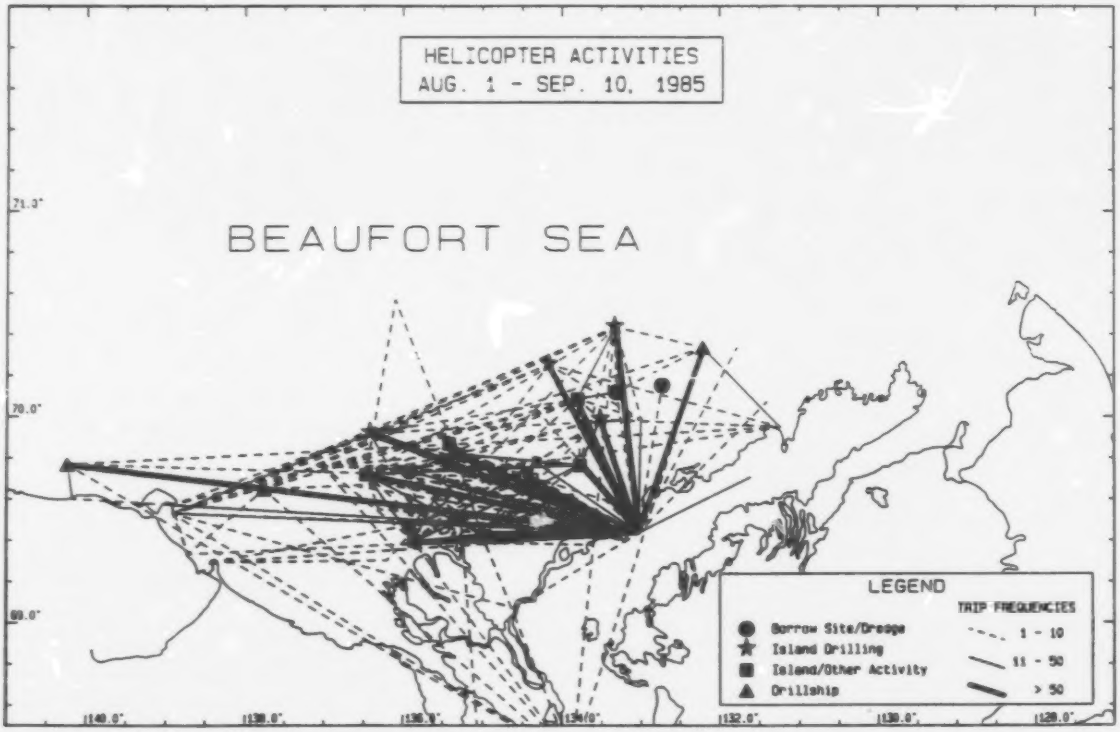


Figure 4.6-3: Helicopter Activities 1985 Core Period.


HELICOPTER ACTIVITIES
AUG. 1 - SEP. 10, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

Map 4.6-4: Helicopter Activities 1985 Core Period.

4.7 1986 Industrial Activities

Three oil companies (Dome, Esso and Gulf) were active in the Beaufort Sea region during the June 01 to December 31, 1986 study period. Oil was recovered from Dome's Havik B-41 exploratory well and Gulf's Amauligak I-65A exploratory well. Gas was tested at a rate of 565 thousand cubic metres per day at Esso's Adgo G-24 well. Continued drilling of delineation wells at Gulf's Amauligak site tested oil at up to 2067 cubic metres per day (COGLA, 1987).

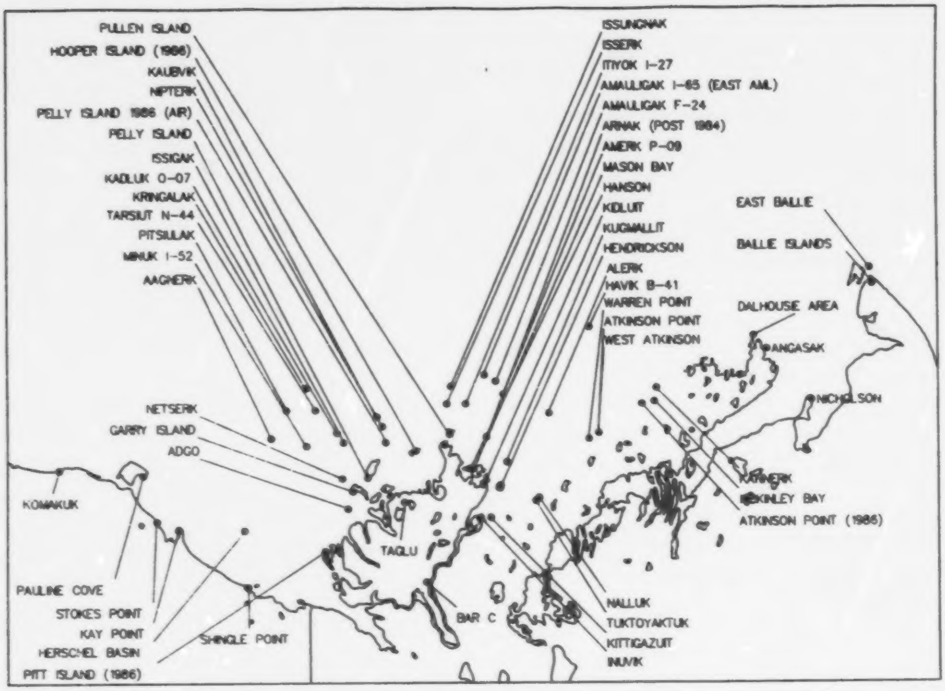
The most important aspect affecting the level of industrial activities in the Beaufort Sea region in 1986 was the low ($10 US or so) world price for a barrel of oil. Oil companies responded to this low price by cutting back on exploration in some frontier areas, such as the Beaufort Sea, where production and delivery of oil would be more expensive. This cut-back affected not only the level of activities within the drilling season but also the length of the season. The level of industrial activities in 1986 was significantly less than that of previous years.

The zone of most industrial activities in 1986 was smaller than that for 1985. Its outer boundary extended from Tuktoyaktuk to McKinley Bay to Havik to Amauligak to Kaubvik to Kringalak to Aagnerk to Herschel Basin to Adgo and back to Tuktoyaktuk. Particularly high activity levels were recorded in the region between Aagnerk and Havik (see Map 4.7-1a, b).

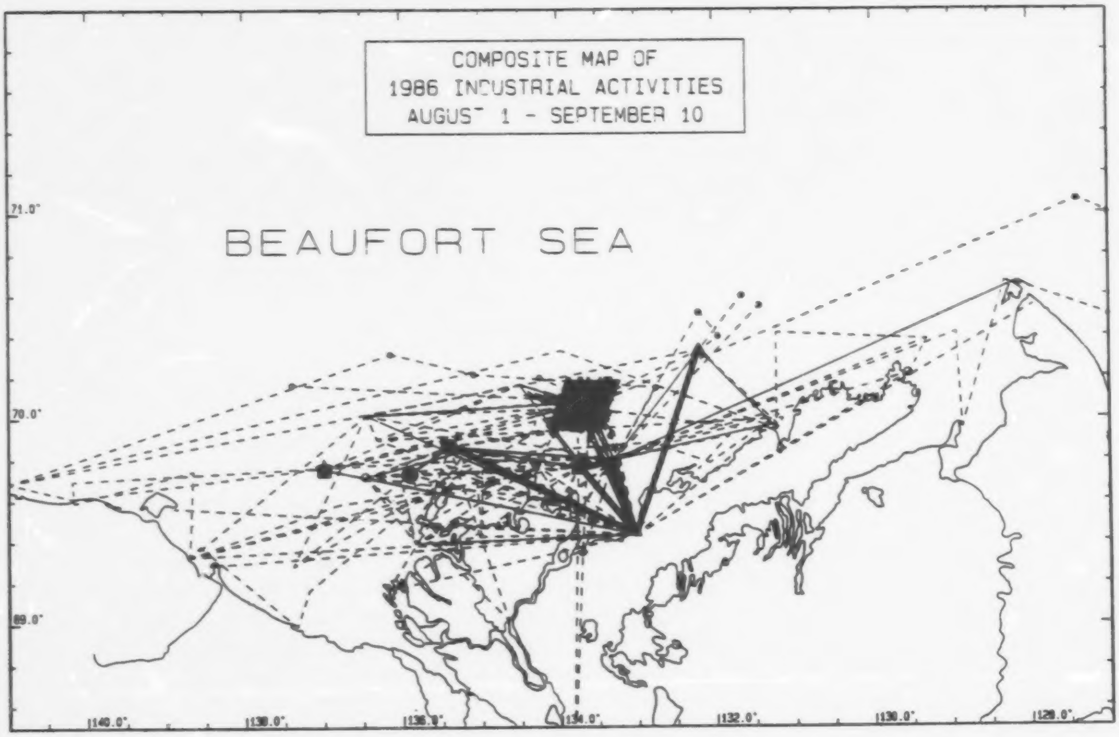
4.7.1 Seismic and Sounding Activities

Seismic surveys in 1986 were conducted by only one vessel, the GSI Explorer. This vessel employed a large airgun array and was active from August 11 to October 1. In the aftermath of oil discoveries at Amauligak north of Kugmallit Bay, intense seismic surveys were done in a relatively small region (about 1000 km^2) centered about the site. Seismic exploration was particularly active in mid August and early September (see Figure 4.7-1).

Sounding surveys were conducted using three vessels, the Immerk, the Marjory and the Nanabush. The first sounding survey occurred on July 22 and the last one on September 6. Sounding activities were most intense during the July 22-31 period. A total of six grids (spot locations) and two lines were shot. Most locations were surveyed once, with the exceptions of Kaubvik (11 occasions), Minuk (6), and Arnak (2) (see Map 4.7-2).


PULLEN ISLAND
HOOPER ISLAND (1986)
KAUBVIK
NIPTERK
PELLY ISLAND 1986 (AIR)
PELLY ISLAND
ISSIGAK
KADLUK O-07
KRINGALAK
TARSIUT N-44
PITSILLAK
MINUK I-52
AAGNERK
ISSUNGNAK
ISSERK
ITIYOK I-27
AMAULIGAK I-65 (EAST AML)
AMAULIGAK F-24
ARNAK (POST 1984)
AMERK P-09
MASON BAY
HANSON
KIDLUIT
KUGMALLIT
HENDRICKSON
ALERK
HAVIK B-41
WARREN POINT
ATKINSON POINT
WEST ATKINSON
EAST BALLIE
BALLIE ISLANDS
DALHOUSIE AREA
ANGASAK
NICHOLSON
NETSERK
GARRY ISLAND
ADGO
KOMAKUK
TAGLU
KANNERK
McKINLEY BAY
ATKINSON POINT (1986)
PAULINE COVE
STOKES POINT
KAY POINT
HERSCHEL BASIN
PITT ISLAND (1986)
SHINGLE POINT
BAR C
NALLUK
TUKTOYAKTUK
KITTIGAZUIT
INUVIK

Map 4.7-1a: 1986 Active Industrial Sites.


COMPOSITE MAP OF
1986 INDUSTRIAL ACTIVITIES
AUGUST 1 - SEPTEMBER 10
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

Map 4.7-1b: All 1986 Industrial Activities.

4.7.2 Site-Specific Activities

Two drillships (the Explorer I and the Kulluk), one mobile drilling platform (the Molikpaq) and two land drilling rigs (Rig 3 and Rig 32) operated in the study area in 1986. The Explorer I was on-site at Havik from July 20 to August 24. The Kulluk was at Aagnerk from June 16 to August 7 and at Kringalak from August 8 to 29. The 'Molikpaq' started drilling at Amauligak I-65 before June 1 and ceased operations there in late September.

Drilling from islands using land rigs occurred throughout the June 01 to December 31 study period. Drilling occurred at Arnak until August 12 and at Kaubvik from October 22 until after December 31. Although Rig 20 was at the Hanson location, there was no drilling there during the June 1 to December 31 study period.

Two trailing suction hopper dredges (the Geopotes X and the W.D. Gateway) were active in the Beaufort Sea region in 1986. The Geopotes X worked at Amauligak F-24. The W.D. Gateway helped in the construction of a caisson-retained island at Kaubvik (with fill taken from two sites, Issigak and Nipterk) and dredged on-site at Arnak and Kaubvik. Dredging activity in the study area commenced on July 20 and continued until September 11. There was no further dredging in September and only on two additional days in October.

4.7.3 Vessel Activities

Thirty-nine vessels operated in the study area in 1986. This is roughly half the number of vessels that operated in the same region the year before. Overall, 962 trips were logged during 1986, compared with 2617 during 1985. There was also less 1986 traffic during the August 1 to September 10 Core Period; 482 trips were made in 1986, compared with 1124 for the same period in 1985. The intensity of vessel traffic was relatively constant throughout the Core Period (see Figure 4.7-2).

The level of vessel activity was low (18 trips) in June, but increased in July and August. After August, the level of activity started to decline. There were only 76 vessel trips in October and none in November or December (see Figure 5.2-3).

During June and July, most vessel movements were from over-wintering sites in Herschel Basin and Tuktoyaktuk to offshore locations. These movements were associated with the start-up of island/construction and drilling activities and were concentrated within and just north of the Mackenzie estuary. Some small-scale movements were associated with ice avoidance and breaking of ice during ice patrols. There were a few vessel trips to Alaska in support of contract work by Dome (Canadian Marine Drilling Limited) in Alaskan waters (see Map 4.7-3).

In early and mid August most vessel activity was still concentrated within and just north of the Mackenzie estuary and there were more trips farther to the east and west than during earlier periods. Starting in late August and continuing through October, vessel activities did not concentrate within the estuary; rather most extended from Tuktoyaktuk to the eastern and western portions of the study area and beyond. In October, most of the vessel movements were to the east (Summers Harbour), out of the study area.

4.7.4 Helicopter Activities

Eight helicopters operated offshore in the Beaufort Sea region in 1986, logging 3376 trips compared to 8205 in 1985. Late July was the most active 10-day period. The intensity of helicopter traffic decreased steadily after July (see Figure 4.7-3).

The level of helicopter activities declined from 845 trips in June to 92 trips in December (see Figure 5.2-4). Helicopters were most active in July.

Helicopter activities were concentrated within and just north of the Mackenzie estuary from June through October (see Map 4.7-4). The most frequent flight routes were between Tuktoyaktuk and drilling rig sites, or between drilling rig sites or, in June, between Tuktoyaktuk and other over-wintering sites. In November and December, almost all flights were between Inuvik and the only active offshore drilling rig site, Kaubvik.

Throughout the June 1 to December 31 period, there were generally more flights to sites with active drilling rigs than to sites where the drilling rig was inactive or being set up or being dismantled. The helicopter trips between Tuktoyaktuk and Summers Harbour, one of the most important over-wintering sites for 1986-87, were not logged in the database because the flight path between these two sites was over land.

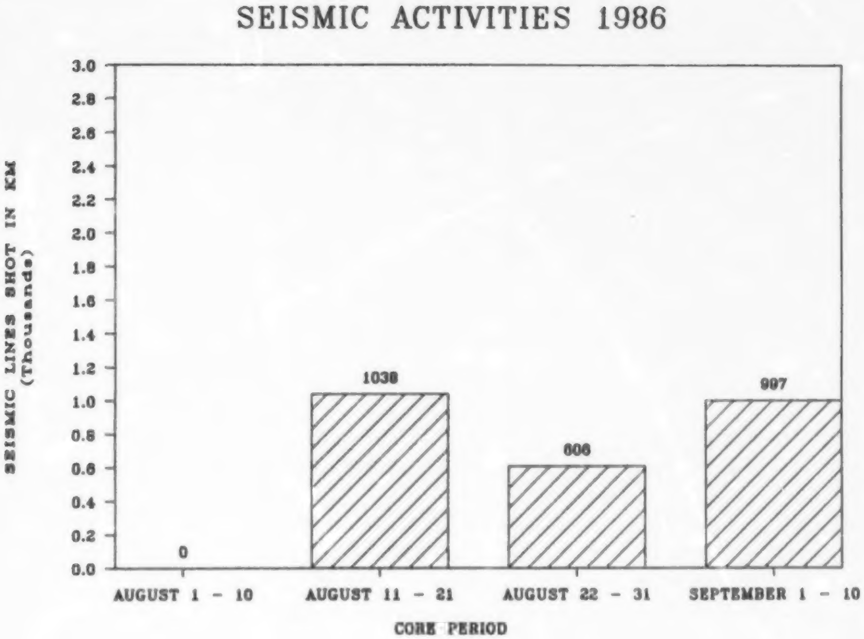
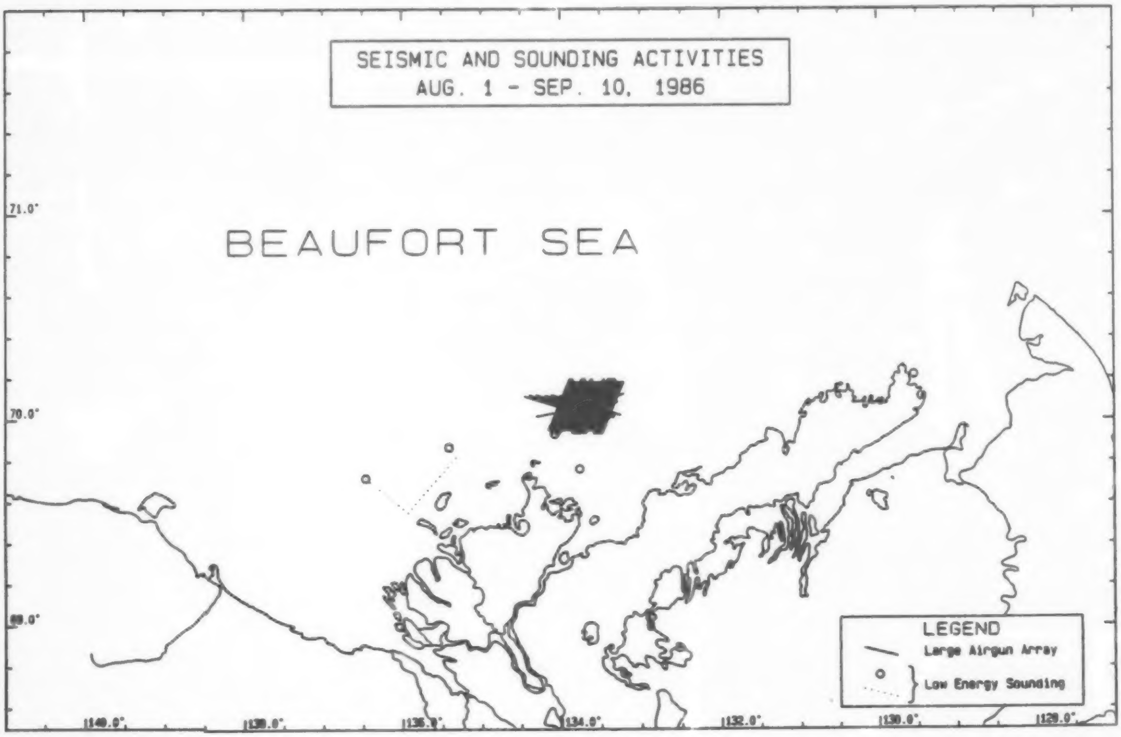


Figure 4.7-1: Seismic Activities 1986 Core Period.


SEISMIC AND SOUNDING ACTIVITIES
AUG. 1 - SEP. 10, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Low Energy Sounding

Map 4.7-2: Seismic Activities 1986 Core Period.

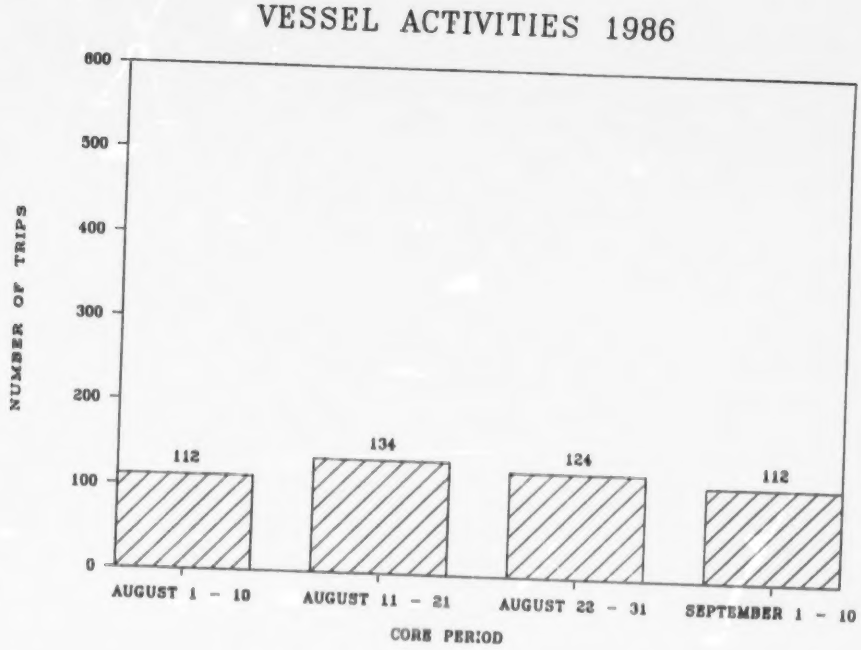
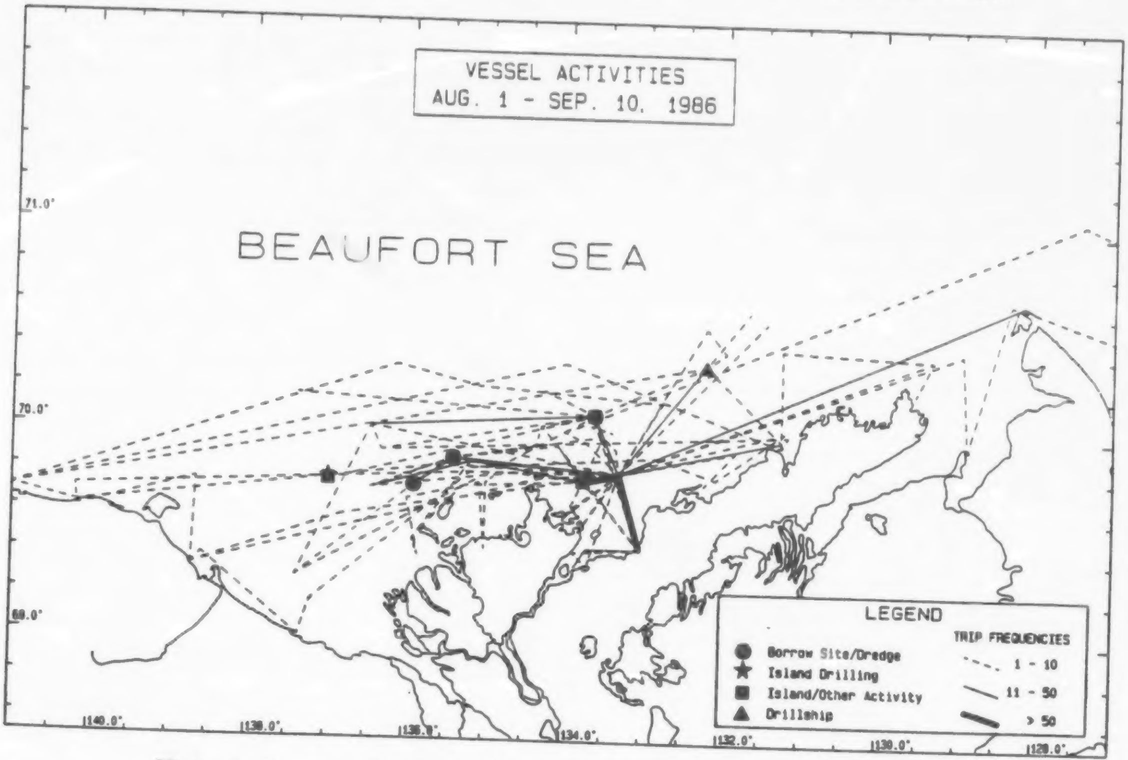


Figure 4.7-2: Vessel Activities 1986 Core Period.


VESSEL ACTIVITIES
AUG. 1 - SEP. 10. 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
TRIP FREQUENCIES
1 - 10
11 - 50
> 50

Map 4.7-3: Vessel Activities 1986 Core Period.

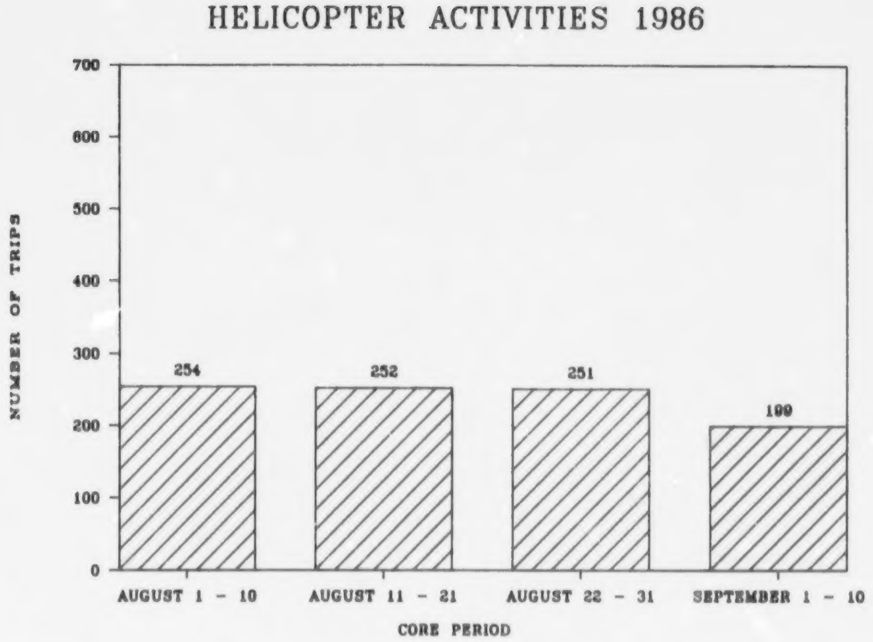
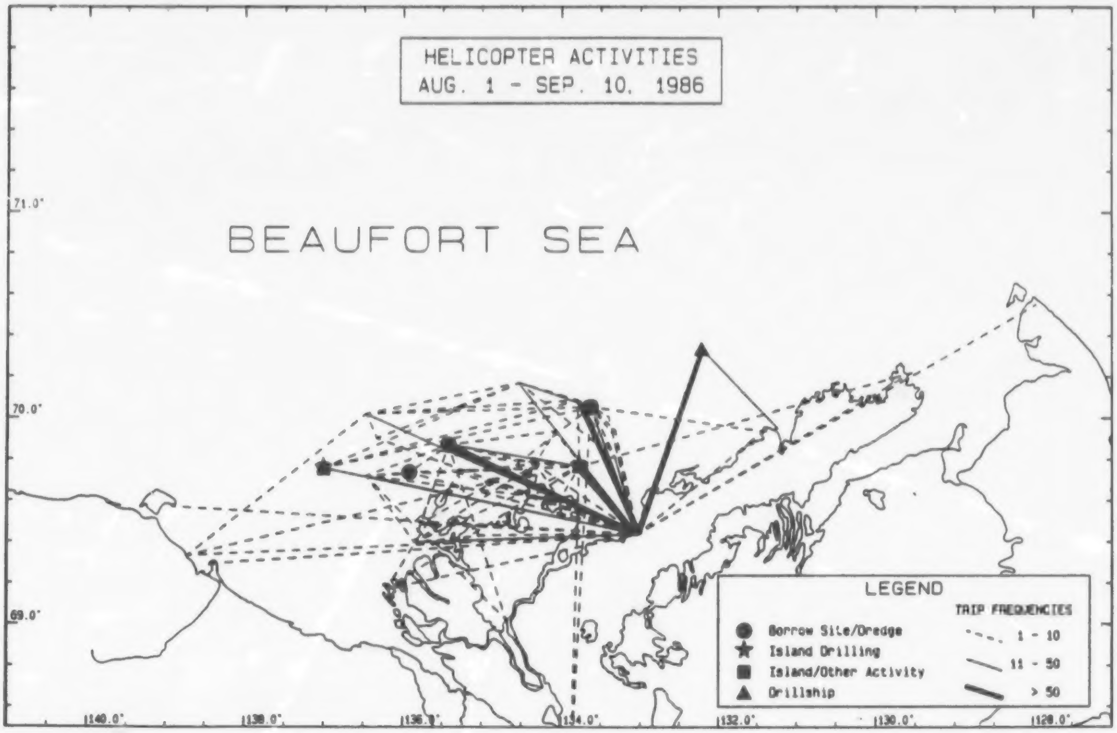


Figure 4.7-3: Helicopter Activities 1986 Core Period.


HELICOPTER ACTIVITIES
AUG. 1 - SEP. 10, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

Map 4.7-4: Helicopter Activities 1986 Core Period.

5. COMPARISON OF 1980-86 INDUSTRIAL ACTIVITIES

Comparisons of industrial activities between years are dependent on the completeness of the database. For all years 1980 to 1986, only the core period of August 1 to September 10 has complete data for all seven years with the exception of 1980 helicopter data. However, for 1985 and 1986, the levels of industrial activity are directly comparable over a much longer period, June 1 to December 31, for which there are complete details. In 1981, data are also available for the July 22 to 31 period; however, a comparison of the three years (1981, 1985, 1986) for July 22 to 31 was not made in this report, because other factors, e.g. ice patterns and weather, had a significant effect on the timing of industrial activities within such a small time frame (10 days). Information on vessel, aircraft and seismic activities in the study area before 1980 are very limited (Richardson ed., 1985).

5.1 Year to Year Variations in Activities

Attempts to define the main industrial zone (MIZ) each year in the Beaufort Sea have been made in several previous studies (Richardson ed., 1983; Richardson ed., 1984; Richardson ed., 1985; Duval, 1986; Norton and McDonald, 1986; Norton *et al.*, 1987). In all of these studies, seismic and sounding activities were considered separately and were not used in defining the MIZ. In this report, composite plots were prepared of all activities including seismic and sounding surveys to describe graphically the main areas of industrial activities.

The location of the geographic center of the main industrial zone has remained relatively constant from 1980 to 1986. The areas north and northeast of Richards Island have consistently been within the MIZ. The extent of activity to the east and west of this core area has changed from year to year. The 1981 boundary extended farther east and to the west as compared with 1980 (Map 4.1-1b, Map 4.2-1b). In 1982, 1983, 1984 and 1986 the main industrial zones were quite similar, i.e. they extended from Herschel Island in the west to McKinley Bay in the east (see Maps 4.3-1b, 4.4-1b, 4.5-1b, 4.7-1b). The 1985 MIZ extended farther west than in any other year since 1979 (Map 4.6-1b).

A rigorous quantitative comparison of the levels of industrial activities from year to year was not attempted because:

1. Weather affects the levels of activities during specific time periods and, for five of the seven years, information is available for a shorter time period than for the two other years.
2. Information on activities before August or after September 10 is not available for the years 1980-84 (except for the July 22 - 31 period in 1981).

3. The study area was expanded in 1985 to include nearshore areas (water depths shallower than 10 m).

4. The number of trips travelled by an aircraft or vessel over time depends on the lengths of the trips; a vessel or aircraft takes less time to complete a short trip than a long trip, and therefore can make more short trips in a time period than long trips. Therefore, the total distance travelled rather than the total number of trips made is probably a better indicator of the intensity of helicopter or vessel activities.

5. Some vessels and helicopters are not exclusively dedicated to industrial work. Therefore, the total number of active vessels or helicopters during a particular period may be somewhat unrepresentative of the actual level of industrial activities during that period.

6. Detailed information on the number of working hours/vessel or aircraft is not readily available.

Estimates of the industrial activity levels that are least affected by these limitations are the number of dredges, drillships, seismic vessels and helicopters operating in the region. With the exception of helicopters, all of these vessels tend to operate continuously once on contract, are taken out of the area or put in storage if not in use, and are affected less than other machinery by weather constraints. Hence, the relative numbers of these vessels better indicate the intensity of activity while activity is occurring, as opposed to the length of the active season.

5.1.1 Seismic and Sounding Activities

The number of active seismic vessels in the study area increased from two in 1980 to five in 1983, and declined thereafter (see Figure 5.1-1). Only one seismic vessel, the GSI Explorer, was active in 1986.

Most seismic and sounding activities occurred north of Richards Island and the western Tuktoyaktuk Peninsula. Seismic lines were shot as far west as the Alaska-Yukon border (in 1981, 1983, and 1984), and as far east as the Baillie Islands (in 1980, 1981, and 1984). Seismic and sounding information was incomplete for most years; no sounding information was available for 1980 and 1984.

According to the number of lines shot, 1984 was the year with the highest level of sounding and seismic activity during the core period (see Figure 5.1-2). In terms of kilometres of lines shot, however, 1981 was the year with the most active core period (Figure 5.1-3). Fewer seismic lines and fewer kilometres of line were shot during 1985 than during any other year in our study. The mean length of a seismic line shot in the study period during all the 1980-86 core periods was about 32 kilometres. The mean length of a seismic line shot ranged from a minimum of 15 kilometres in 1985 to a maximum of about 48 kilometres in 1981.

Another possible method of measuring the level of seismic and sounding activity is by calculating the number of hours seismic and sounding vessels were active during a time period. This method would perhaps give the best estimate of the true level of seismic and sounding activity, since seimic vessels travel at different speeds depending on the type of survey gear deployed (Richardson ed., 1983). Unfortunately, such information was not available for this report.

Sounding activities were most intense in 1982 when 26 different locations were surveyed.

5.1.2 Site-Specific Activities

The number of specific industrial sites actively occupied in the Canadian Beaufort Sea increased from seven in 1980 to nineteen in 1985 (Figure 5.1-4). In 1986 there was a sharp decline in all types of industrial activities and only eight sites remained active. Active sites extended as far north and east as Killannik in 1980 and as far west as the Edlok site in 1985. Drillships operated at both these sites.

According to the number of dredges, drillships or seismic vessels operating, 1983 was the year with the highest level of activity in the Beaufort Sea region, and 1986 was the year with the lowest level (see Figures 5.1-5, 5.1-6, and 5.1-1 respectively). This is in agreement with Norton _et al._ (1987).

The number of wells spudded followed the same pattern as number of dredges, drillships and seismic vessels operating for 1980 to 1984 (Figure 5.1-7). Then, in 1985, the number of wells spudded increased while the number of dredges, drillships and seismic vessels operating remained the same or decreased. Three of the new wells spudded in 1985 were delineations at old sites and 10 were at onshore locations; thus the number of wells spudded is not a reliable indicator of offshore activity, at least in 1985. The number of wells spudded in offshore locations was not readily available for 1980, 1981 and 1983. The number of wells drilled and terminated should not be used as an indicator of industrial activity since many wells are spudded one year, re-entered for one or two years, and then terminated. Dredging, which accounts for a large proportion of the vessel trips, may also have ceased one or more years before a well was terminated, and the number of wells drilled and terminated is likewise a poor indicator of the level of industrial activities.

5.1.3 Vessel Activities

In terms of the number of vessel trips made during the core period, 1984 and 1986 were the years with the most and least activity respectively (see Figure 5.1-8). Perhaps a better way to determine the level of vessel activities is by considering the distance vessels travelled over each time period. However, this information is not available.

Most vessel movements occurred north of Richards Island and the western Tuktoyaktuk Peninsula. Vessel traffic was particularly heavy between Tuktoyaktuk and the various offshore sites. In all years (except 1985) vessels made several trips to points east and west of the study area. A few vessels also made trips to and from Inuvik.

5.1.4 Helicopter Activities

In terms of the number of operating helicopters, 1985 was the year with the most activity and 1980 was the year with the least activity (Figure 5.1-9). 1985 was also the year with the most helicopter trips, i.e. there were 2220 helicopter trips between August 1 and September 10 1985. The year in which the fewest trips (956) were recorded during the Core Period was 1986 (see Figure 5.1-10). Again, caution is required regarding these conclusions. Specific data on helicopter movements were not available for 1980, and the helicopter database for years prior to 1985 is incomplete.

In general, the pattern of helicopter routes was similar to that of the vessel movements; most helicopters flew between Tuktoyaktuk and the offshore industrial sites. No oil-industry helicopters flew to points east or west of the study area.

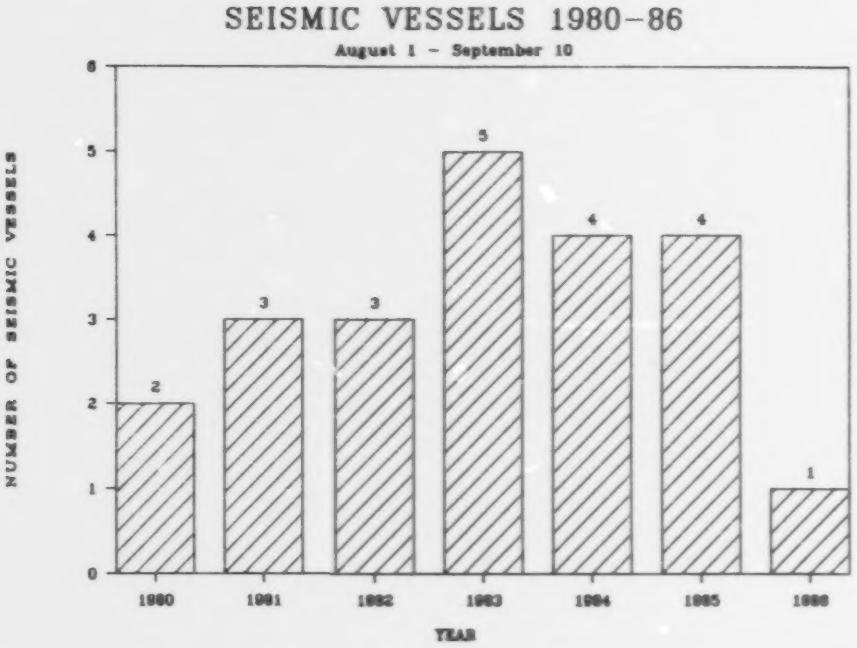


Figure 5.1-1: Seismic Vessels 1980-86.

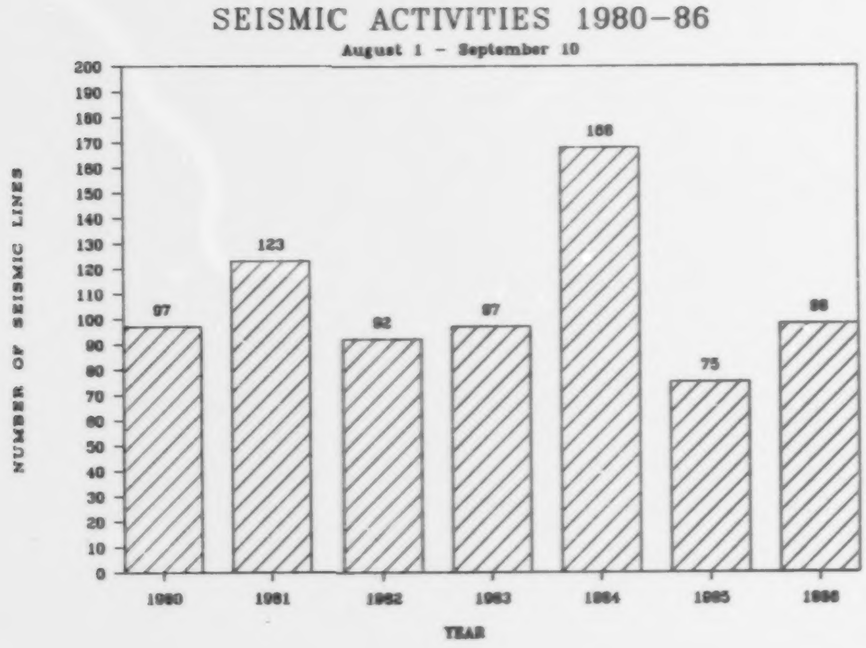


Figure 5.1-2: Seismic Activities 1980-86 (Number of Lines).

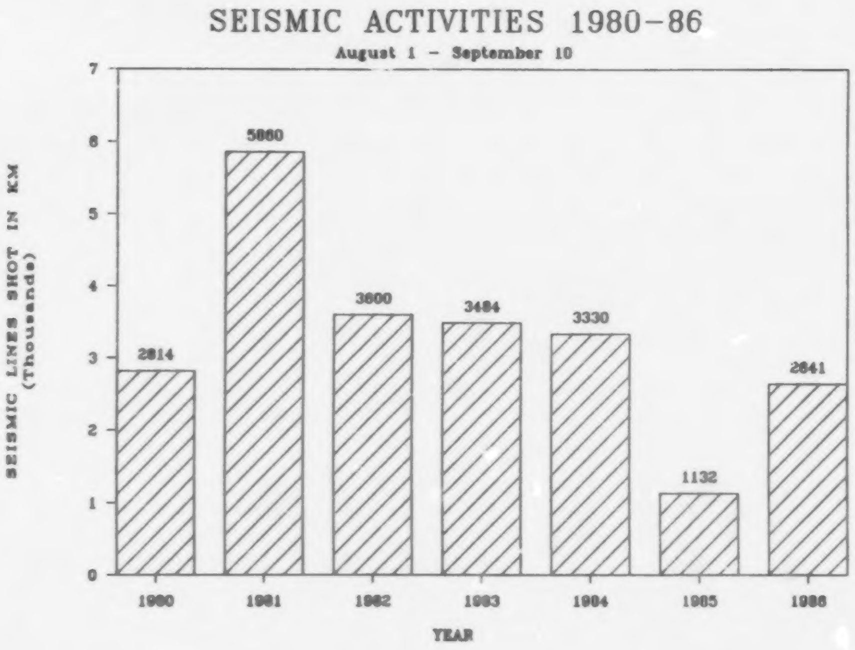


Figure 5.1-3: Seismic Activities 1980-86 (Km of Line Shot).

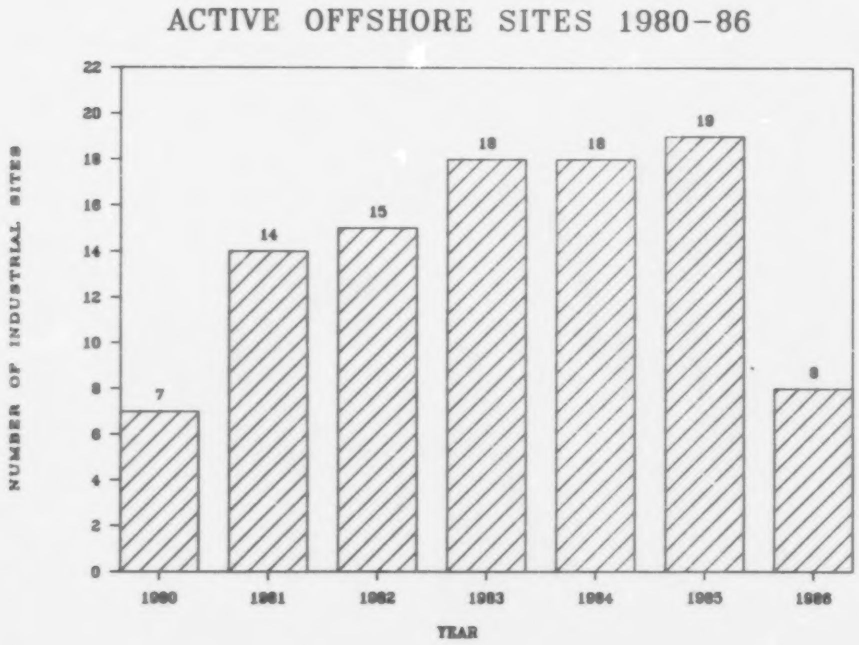


Figure 5.1-4: Offshore Industrial Sites 1980-86.

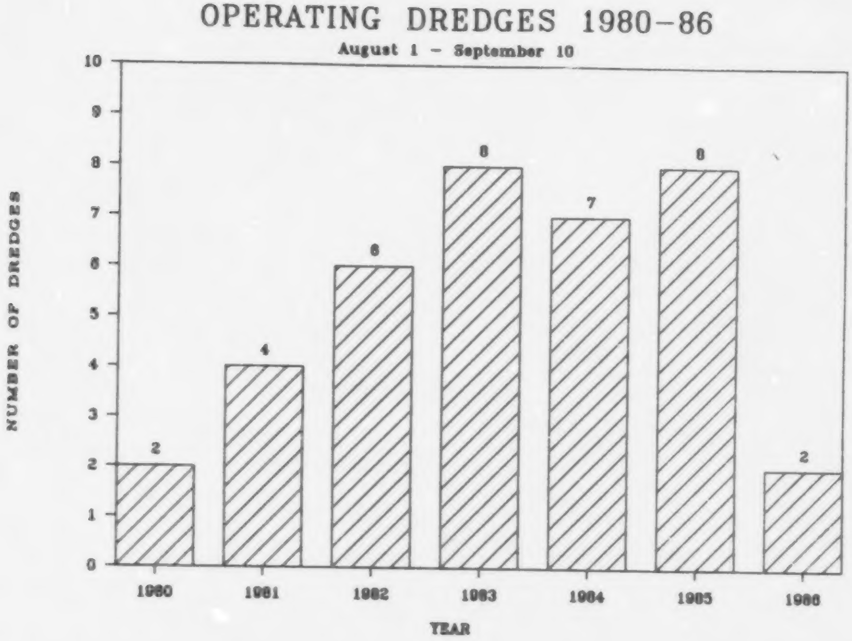


Figure 5.1-5: Dredges 1980-86.

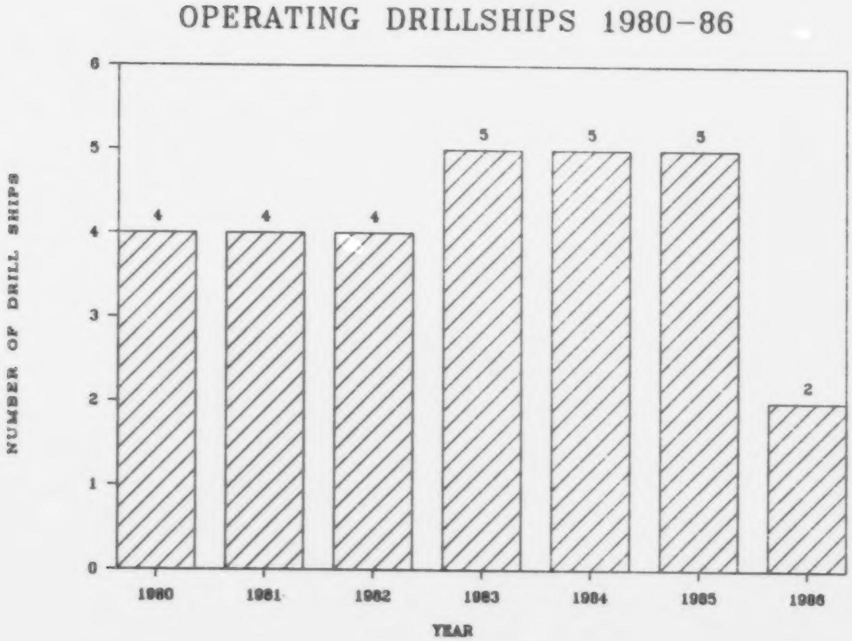


Figure 5.1-6: Drillships 1980-86.

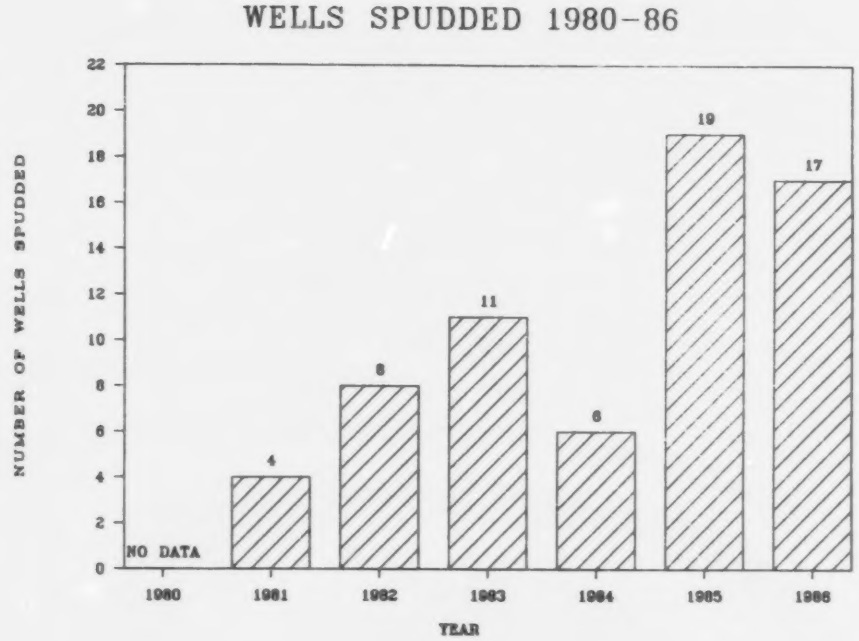


Figure 5.1-7: Wells Spudded 1980-86.

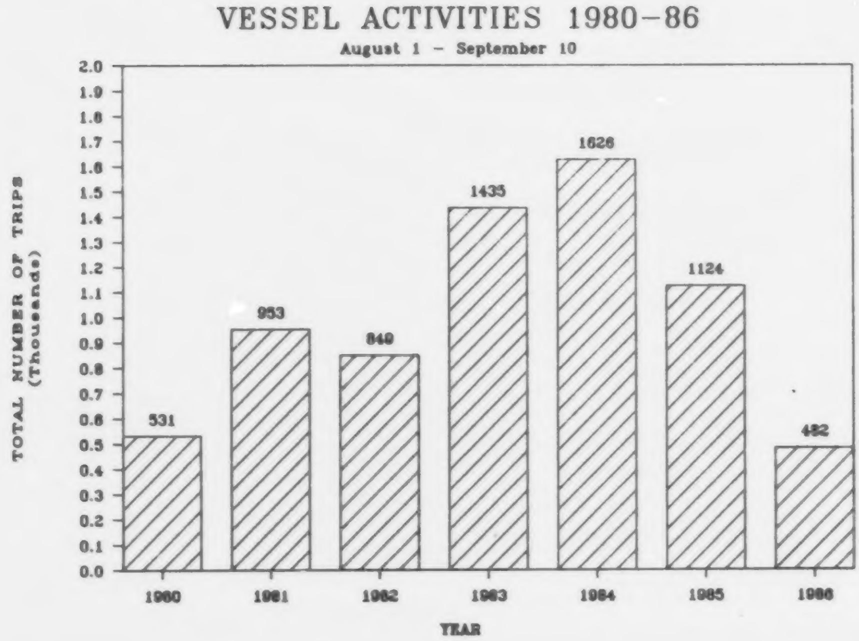


Figure 5.1-8: Vessel Activities 1980-86.

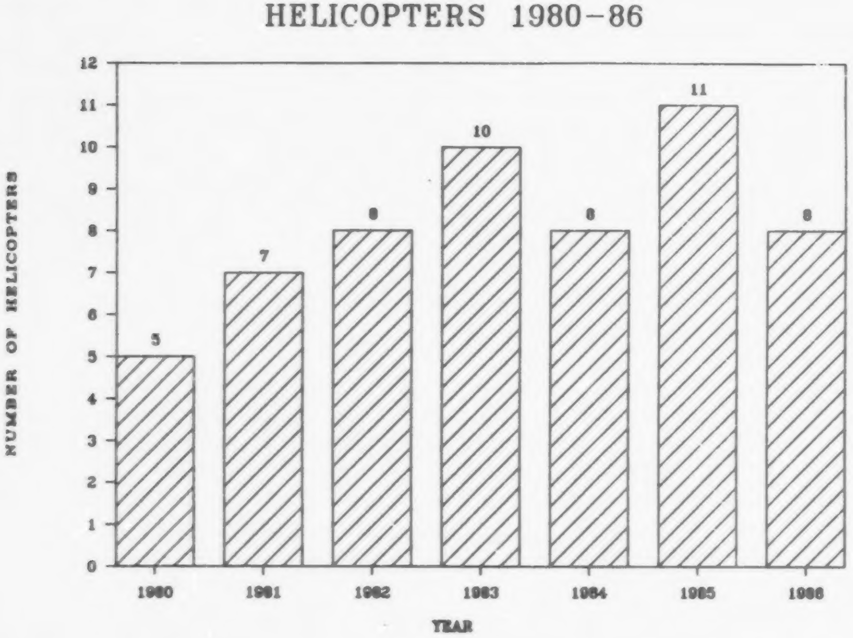


Figure 5.1-9: Helicopters 1980-86.

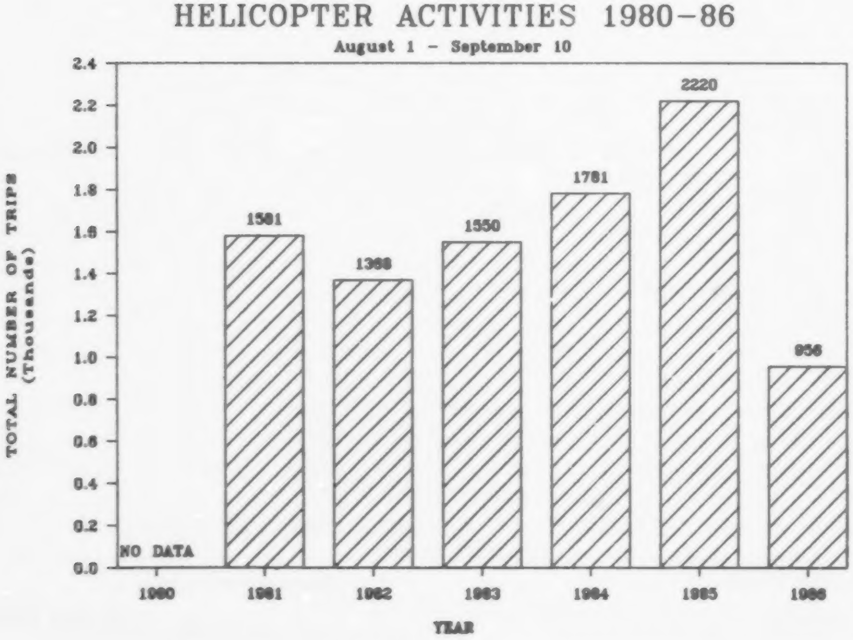


Figure 5.1-10: Helicopter Activities 1980-86.

5.2 Detailed Comparison of 1985 and 1986 Industrial Activities

The main industrial zones (MIZ) for 1985 and 1986 showed considerable overlap (see Figures 4.6-1, 4.7-1). The 1986 MIZ was somewhat smaller. It did not extend as far west as Komakuk or as far north as Nerlerk, Akpak and Arluk, in contrast to the 1985 MIZ. However, the inclusion of Kringalak in the 1986 MIZ did extend its northwest boundary slightly beyond that of the 1985 MIZ. As evidenced by the composite plots of all activities presented in this report, there was also much less activity within the 1986 MIZ than in the 1985 MIZ.

Appendix C presents maps of the various industrial activities for 1985 and 1986 by month.

The level of seismic and sounding activities was much greater in 1986 than in 1985: 4089 km of seismic line were shot during the study period in 1986, compared with only 1330 km shot during the same period in 1985 (see Figures 5.2-1, 5.2-2). Sounding surveys were conducted at six locations in 1986 and only one location in 1985. In 1985 and 1986, seismic surveying began in early August and ended in late September or October. In both years, seismic activity was greatest in September.

The drop in the world price of oil resulted in a dramatic decline in various industrial activities from 1985 to 1986. For example, 2617 vessel trips were recorded between June 1 and December 31, 1985 compared with only 962 trips recorded during the same period in 1986, and 8205 helicopter trips were recorded between August 1 and September 10, 1985 compared with only 3376 during the same period in 1986.

The general monthly trend in number of vessel movements was similar in 1985 and 1986. However, the peak monthly total for vessel movements was 370 trips in August for 1986, as compared with 902 trips in September for 1985 (Figure 5.2-3). Vessels made trips as early as June in 1985 and 1986. In 1985, the open-water season was extended, and vessels made trips as late as December. In 1986, no vessel trips were made after October. The geographic areas of vessel movements in 1985 and 1986 were similar and relatively extensive. Vessels regularly travelled west of Herschel Island and as far east as Baillie Islands.

Helicopter movements were at about the same level of intensity in June of both years. In 1985, the number of movements per month increased from June through September and then declined to about the same level in December as in June. In 1986, there was a steady decline from July through December (see Figure 5.2-4). A total of 92 aircraft movements occurred in December 1986 as compared with 693 in December 1985.

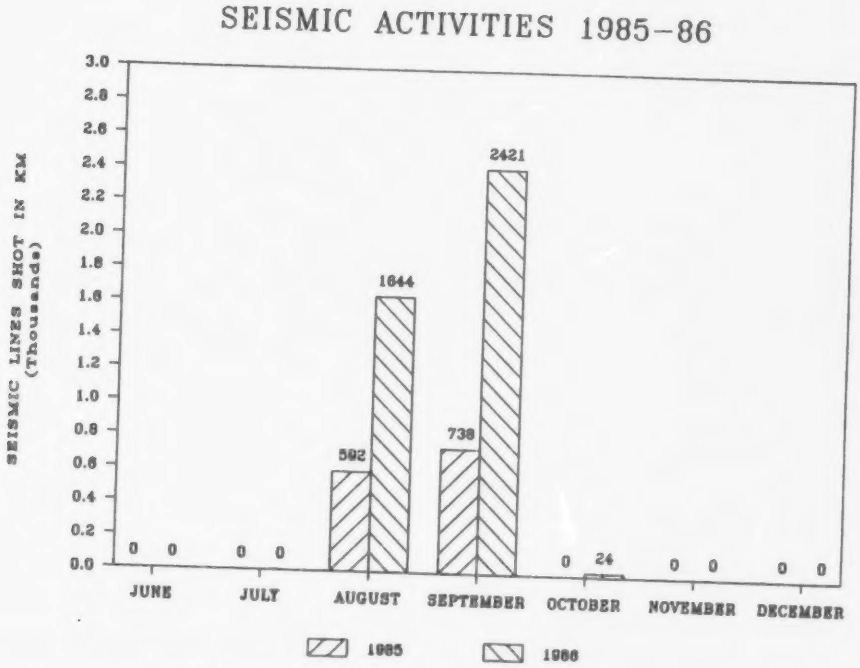


Figure 5.2-1: Seismic Activities 1985-86 by Month (Km Shot).

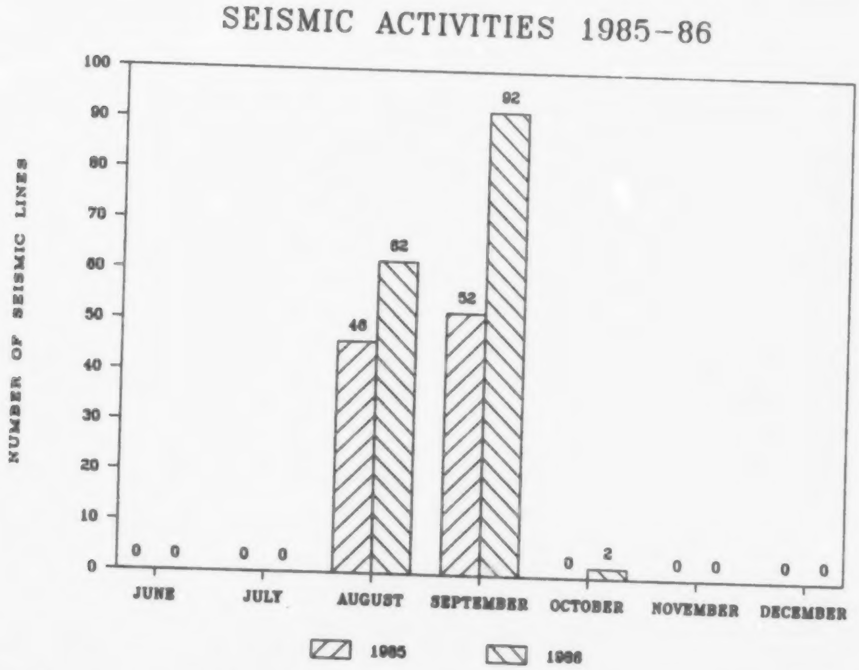


Figure 5.2-2: Seismic Activities 1985-86 by Month (Lines).

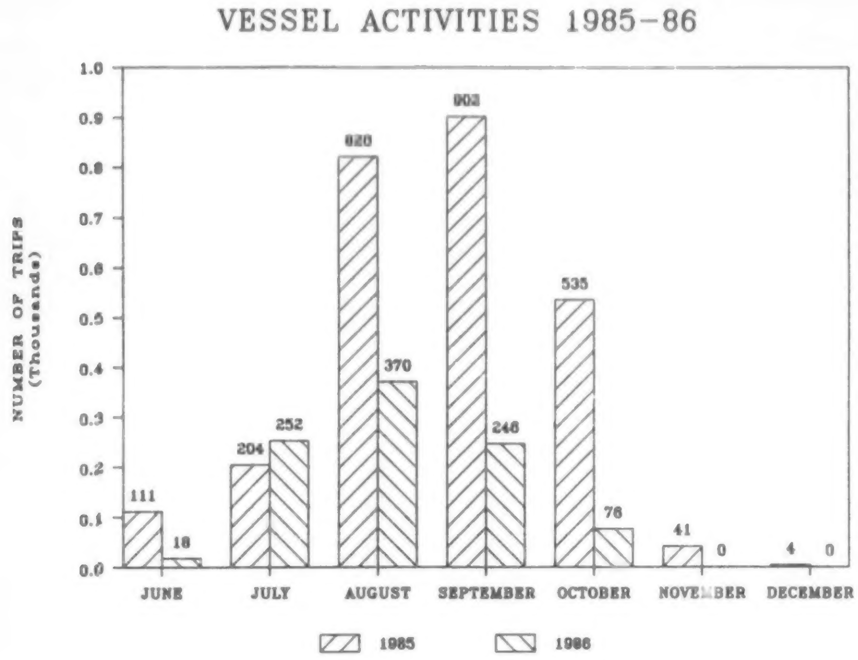


Figure 5.2-3: Vessel Activities 1985-86 by Month.

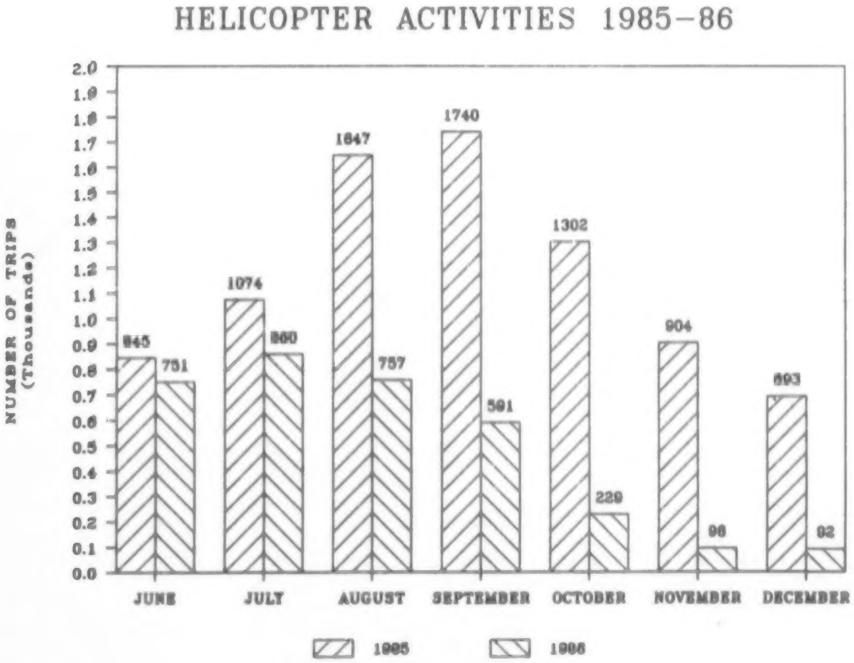


Figure 5.2-4: Helicopter Activities 1985-86 by Month.

6. RECOMMENDATIONS

The major outcome of this project has been the successful compilation, reporting and computerized storage of most available 1980-86 industrial activity information for the Canadian Beaufort Sea. The principal sources of the pertinent industrial activity data have been previous studies whose clear purpose was to describe industrial activities in relation to observed bowhead whale distributions. In the future, this summarized industrial activity database may be useful to new government staff responsible for Arctic resources but unfamiliar with the previous extent of industrial operations in the Canadian Beaufort Sea. It may also be useful for continued assessment of bowhead whale distribution or for the purposes fo broader-based environmental impact assesment, regional planning or other resource management issues in the region. Should there be such a requirement for an update or expansion of this activity database, the following recommendations are made:

1. The overall purpose (s) for which any subsequent industrial activity data would be used should be clearly defined before any additional data are compiled or entered into the database.

2. A standardized set of selection criteria should be developed to address the specific purpose (s) intended for each type of industrial activity information to be compiled and entered into the database. The criteria should address the types and formats of all data required to effectively describe each industrial activity. Effort should be directed at determining what time periods and geographic constraints (vertical and horizontal) should be used for recording and reporting all activity data, bearing in mind the overall purpose (s) and the format of the existing historical information. The review of previous source documents for this 1980-86 study has revealed numerous inconsistencies in the methods used for collecting, recording and reporting the data; the periods and geographic extents over which the data are recorded and/or reported; and the methods by which locations of industrial activities are recorded. For example, the 1985 and 1986 reports included nearshore areas (water depths less than 10 metres) as part of their study area whereas the 1980 to 1984 studies did not; also several reports were inconsistent as to which activities were classified and reported under "vessel activities" and which were under "seismic and sounding activities".

3. Research related industrial activities should be considered for inclusion in the industrial activity database. Some types of research activities, eg. photogrammetry reconnaisance flights at altitudes below 457 metres (1500 feet), have the potential to disturb bowhead whales and other marine species of interest. The major difficulties will be determining which research activities are of interest, establishing standardized recording formats for

all appropriate researchers to keep detailed records of their flight plans and/or vessel logs, and clearing the release of such information to northern regulatory agencies.

4. Non-research fixed-wing aircraft activities at altitudes below 457 metres (1500 feet) also have the potential to disturb bowhead whales and other marine species of interest, and hence should be included in the database. This type of fixed-wing aircraft information was not available, i.e. reported, in the 1980-84 studies, but was in subsequent studies for 1985 and 1986. Northern regulatory agencies keep records of non-research aircraft in the region but not in sufficient detail to be useful, and not by altitude. The records currently kept by the principal operators in the region are sufficient for extraction of this type of data.

5. All pertinent industrial activity data should be compiled annually. This is important because some types of industrial activity data can disappear or become irretrievable over time. If a retrospective compilation is attempted in the future, this means some data may not be available (as was the case for the 1980-81 period).

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APPENDIX A

STRUCTURE OF DATA FILES FOR 1980-86 INDUSTRIAL SITES AND SEISMIC, VESSEL, AND AIRCRAFT ACTIVITIES.

TABLE A-1

STRUCTURE OF DATA FILES FOR 1980-86 INDUSTRIAL SITES AND SEISMIC, VESSEL, AND AIRCRAFT ACTIVITIES.

Structure for database: **LOCATION.DBF**
Number of data records: 146
Date of last update : 11/05/88

FIELD NAME	TYPE	WIDTH	DECIMALS
CODE	Character	7	
LOCATION	Character	26	
YEAR80	Logical	1	
YEAR81	Logical	1	
YEAR82	Logical	1	
YEAR83	Logical	1	
YEAR84	Logical	1	
YEAR85	Logical	1	
YEAR86	Logical	1	
LAT_DEGREE	Numeric	2	
LAT_MINUTE	Numeric	4	1
LON_DEGREE	Numeric	3	
LON_MINUTE	Numeric	4	1

TOTAL RECORD LENGTH: 54

Structure for database: **SEISMIC.DBF**
Number of data records: 1229
Date of last update : 10/05/88

FIELD NAME	TYPE	WIDTH	DECIMALS
TIME	Character	17	
TIME_FRME	Numeric	2	
YEAR	Numeric	4	
NAME	Character	21	
LINE_SHOT	Character	5	
TYPE	Character	3	
STRT_LATDG	Numeric	2	
STRT_LATMN	Numeric	4	1
STRT_LONDG	Numeric	3	
STRT_LONMN	Numeric	4	1
STOP_LATDG	Numeric	2	
STOP_LATMN	Numeric	4	1
STOP_LONDG	Numeric	3	
STOP_LONMN	Numeric	4	1

TOTAL RECORD LENGTH: 79

TABLE A-1 (Continued)

STRUCTURE OF DATA FILES FOR 1980-86 INDUSTRIAL SITES AND SEISMIC, VESSEL, AND AIRCRAFT ACTIVITIES.

Structure for database: **VESSEL.DBF**
Number of data records: 2954
Date of last update : 10/05/88

FIELD NAME	TYPE	WIDTH	DECIMALS
TIME	Character	17	
YEAR	Numeric	4	
NAME	Character	21	
NUM_TRIPS	Numeric	4	
STRT_CODE	Character	7	
STOP_CODE	Character	7	
STRT_LATDG	Numeric	2	
STRT_LATMN	Numeric	4	1
STRT_LONDG	Numeric	3	
STRT_LONMN	Numeric	4	1
MID1_LATDG	Numeric	2	
MID1_LATMN	Numeric	4	1
MID1_LONDG	Numeric	3	
MID1_LONMN	Numeric	4	1
MID2_LATDG	Numeric	2	
MID2_LATMN	Numeric	4	1
MID2_LONDG	Numeric	3	
MID2_LONMN	Numeric	4	1
MID3_LATDG	Numeric	2	
MID3_LATMN	Numeric	4	1
MID3_LONDG	Numeric	3	
MID3_LONMN	Numeric	4	1
STOP_LATDG	Numeric	2	
STOP_LATMN	Numeric	4	1
STOP_LONDG	Numeric	3	
STOP_LONMN	Numeric	4	1
TOTAL RECORD LENGTH:		126	

TABLE A-1 (Continued)

STRUCTURE OF DATA FILES FOR 1980-86 INDUSTRIAL SITES AND SEISMIC, VESSEL, AND AIRCRAFT ACTIVITIES.

Structure for database:	**HELCOPTR.DBF** and	**FAIRCRFT.DBF**
Number of data records:	1995	27
Date of last update :	10/05/88	10/05/88

FIELD NAME	TYPE	WIDTH	DECIMALS
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TIME_FRME	Numeric	2	
YEAR	Numeric	4	
NAME	Character	10	
NUM_TRIPS	Numeric	4	
STRT_CODE	Character	7	
STOP_CODE	Character	7	
STRT_LATDG	Numeric	2	
STRT_LATMN	Numeric	4	1
STRT_LONDG	Numeric	3	
STRT_LONMN	Numeric	4	1
STOP_LATDG	Numeric	2	
STOP_LATMN	Numeric	4	1
STOP_LONDG	Numeric	3	
STOP_LONMN	Numeric	4	1
TOTAL RECORD LENGTH:		78	

APPENDIX B

MAPS OF 1980-86 INDUSTRIAL ACTIVITIES

The following sections present maps of offshore industrial activities in the Canadian Beaufort Sea from 1980-86. Maps are presented by year for activity type.

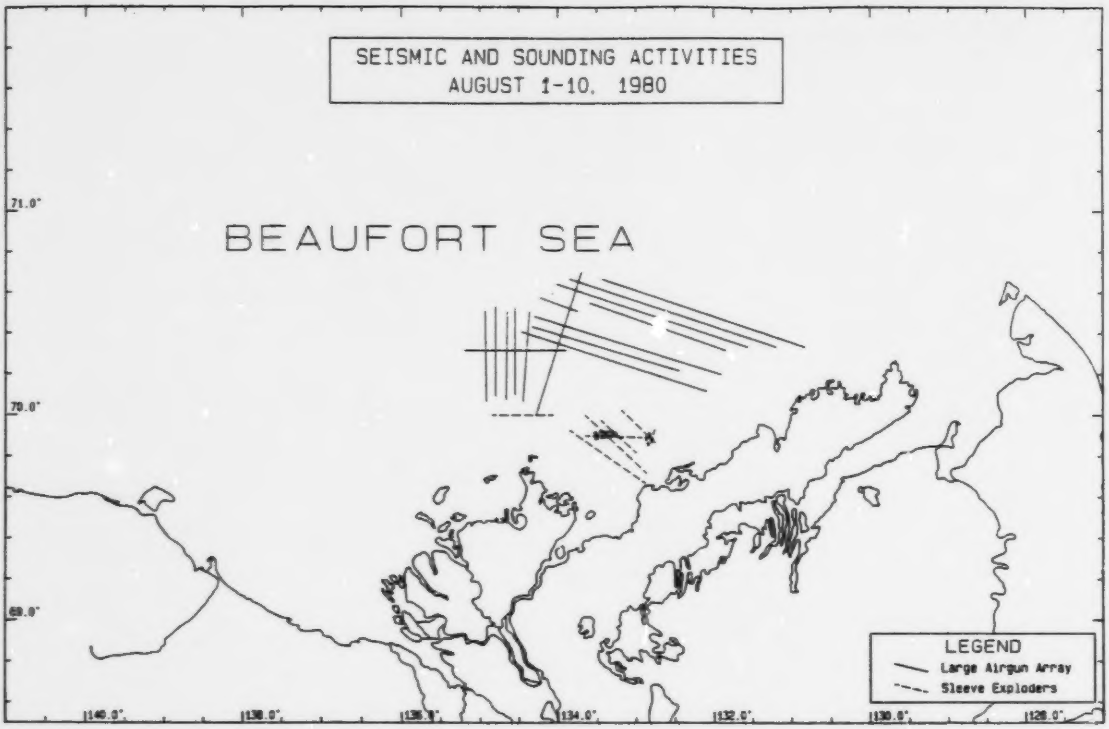
All maps are by 10 or 11-day period.

Maps are not provided for time periods having no reported activities.

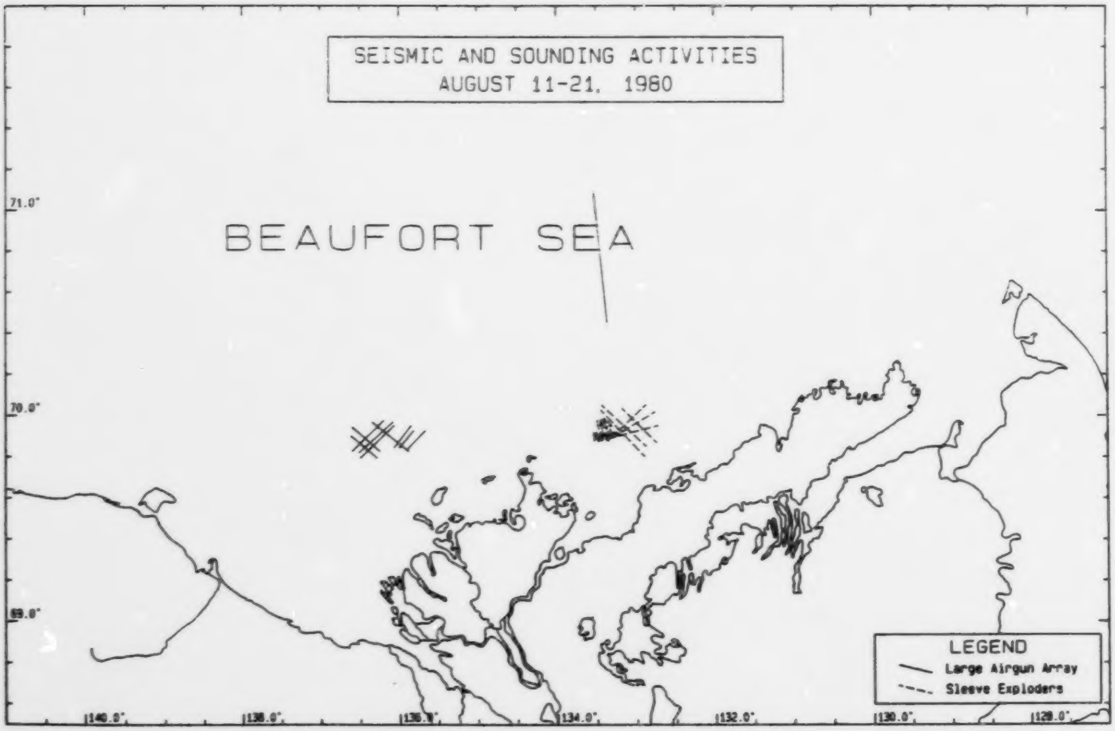
B.1 1980 INDUSTRIAL ACTIVITIES

The following section presents maps of:

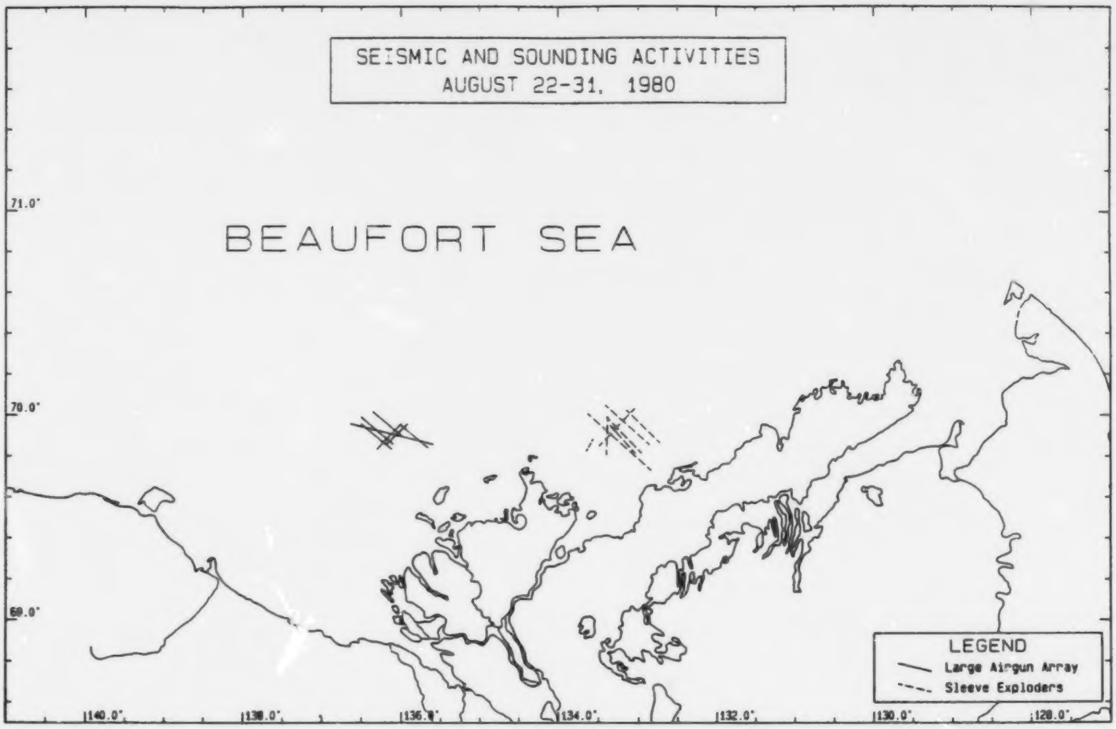
1) 1980 Seismic and Sounding Activities from August 1 to September 10, and
2) 1980 Vessel Activities from August 1 to September 10.


SEISMIC AND SOUNDING ACTIVITIES
AUGUST 1-10, 1980
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Sleeve Exploders

Map B.1-1: Seismic Activities August 1 to 10, 1980.


SEISMIC AND SOUNDING ACTIVITIES
AUGUST 11-21, 1980
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Sleeve Exploders

Map B.1-2: Seismic Activities August 11 to 21, 1980.


SEISMIC AND SOUNDING ACTIVITIES
AUGUST 22-31, 1980
BEAUFORT SEA
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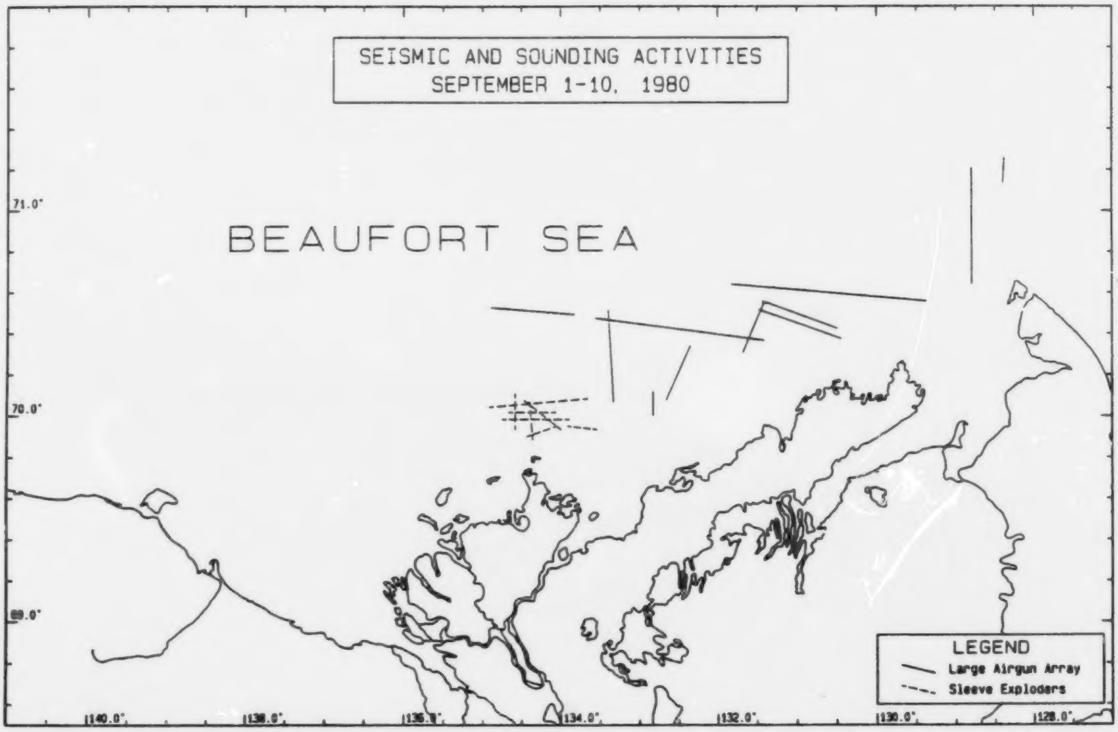
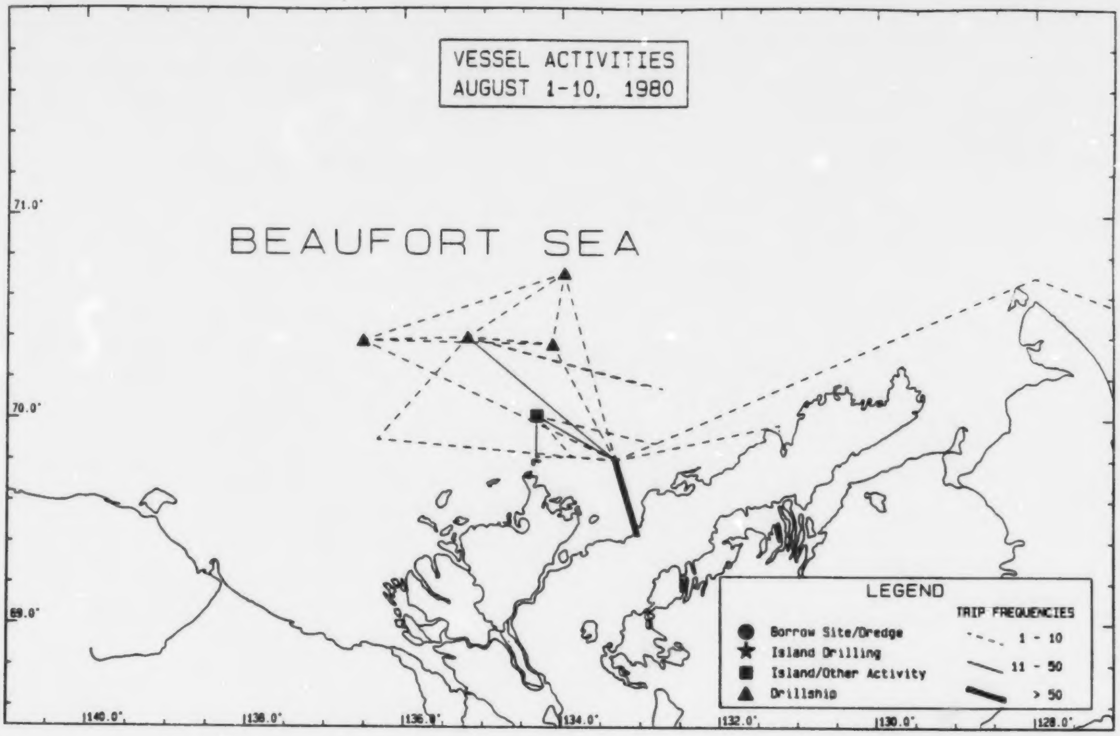
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Sleeve Exploders

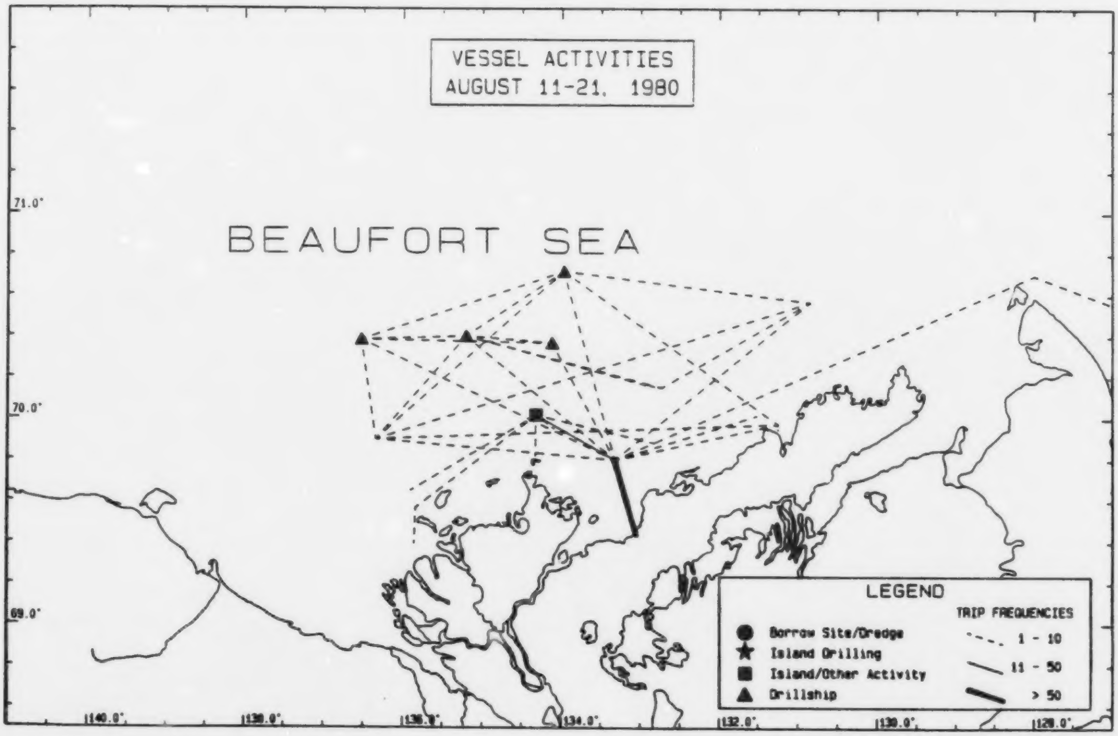
Map B.1-3: Seismic Activities August 22 to 31, 1980.


SEISMIC AND SOUNDING ACTIVITIES
SEPTEMBER 1-10, 1980
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Sleeve Exploders

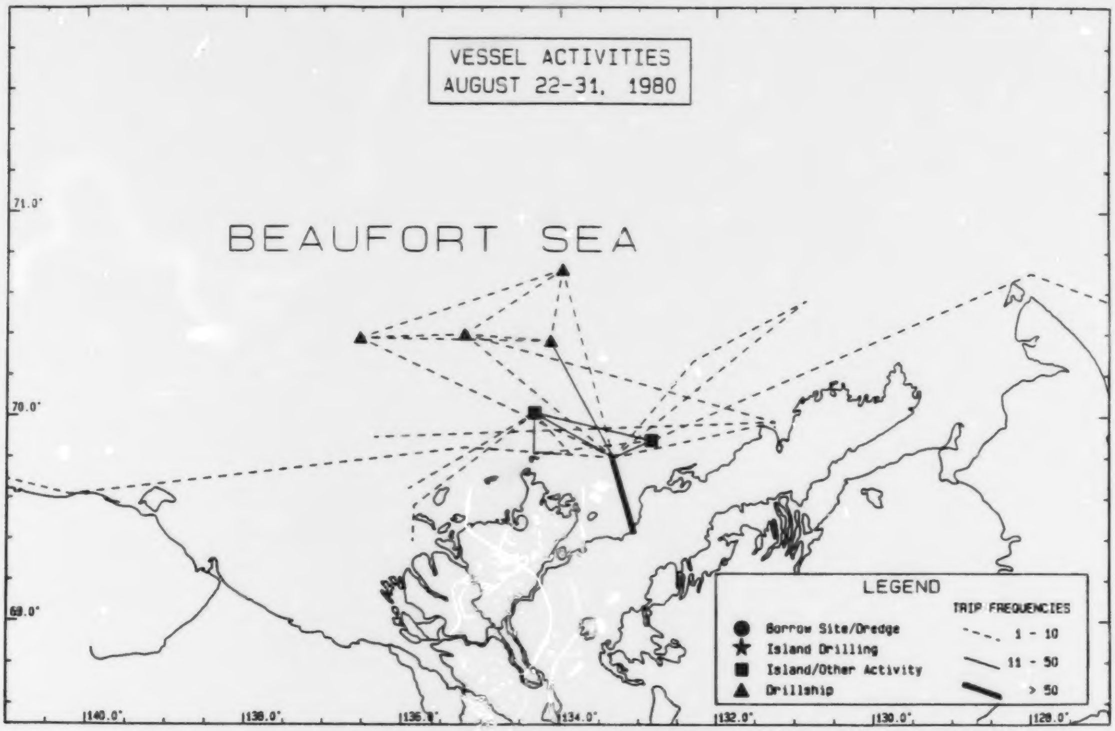
Map B.1-4: Seismic Activities September 1 to 10, 1980.


VESSEL ACTIVITIES
AUGUST 1-10, 1980
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

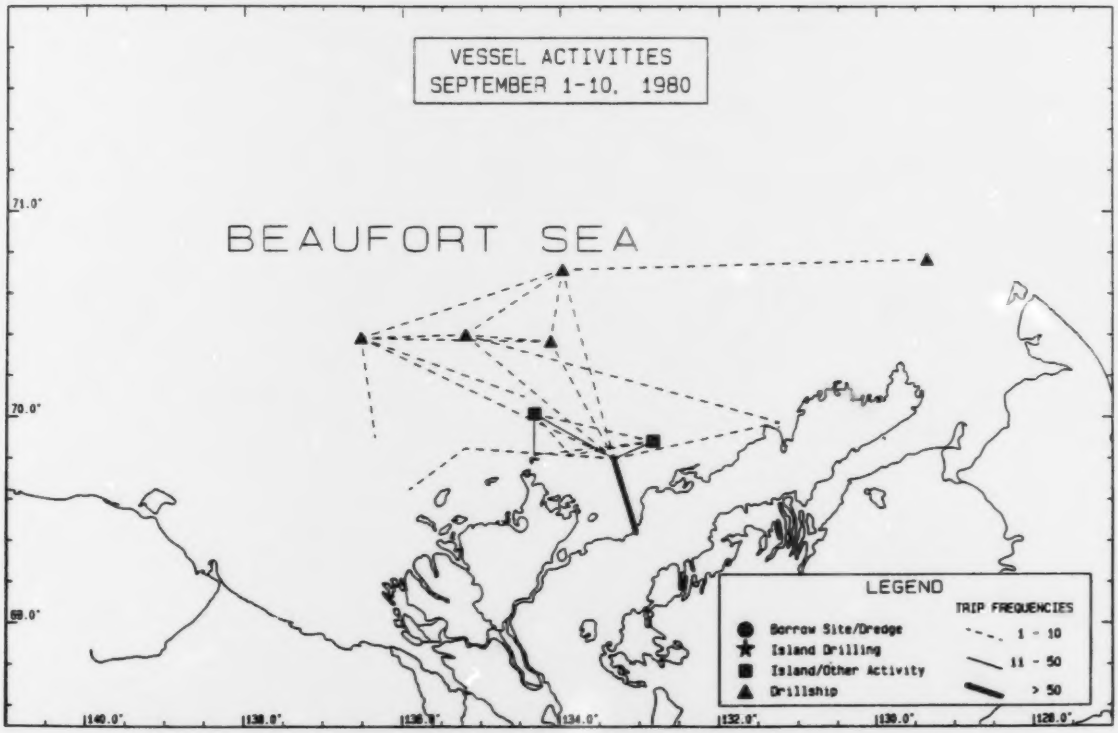
Map B.1-5: Vessel Activities August 1 to 10, 1980.


VESSEL ACTIVITIES
AUGUST 11-21, 1980
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

Map B.1-6: Vessel Activities August 11 to 21, 1980.


VESSEL ACTIVITIES
AUGUST 22-31, 1980
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

Map B.1-7: Vessel Activities August 22 to 31, 1980.

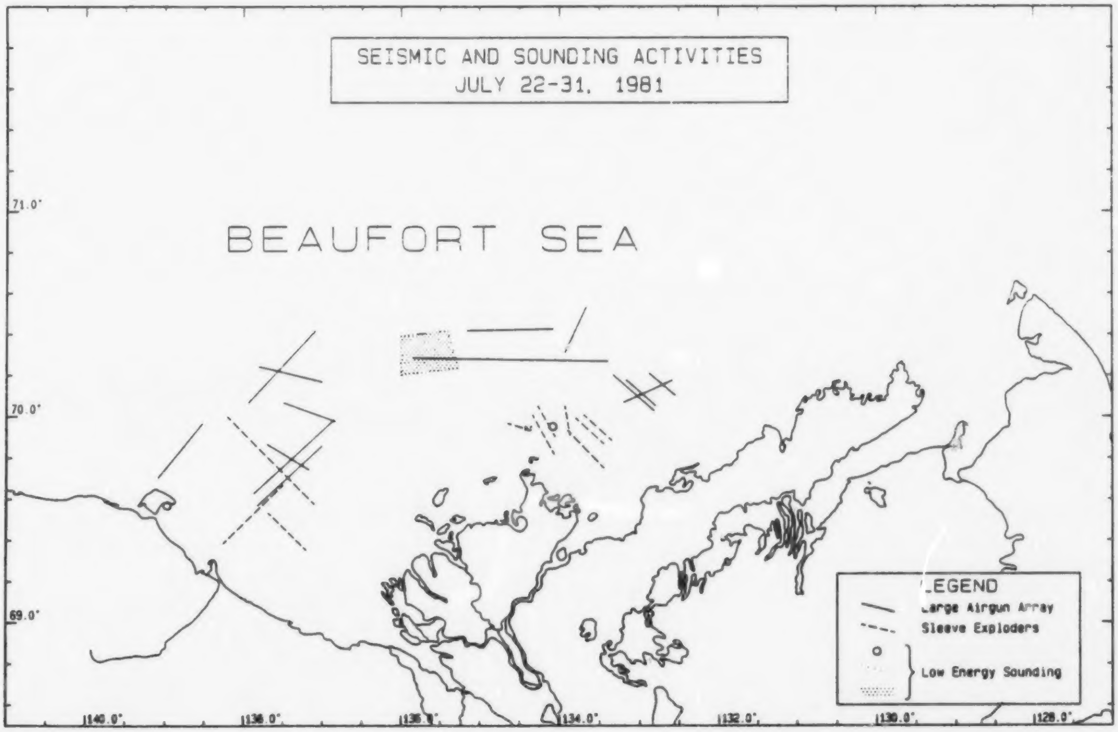

VESSEL ACTIVITIES
SEPTEMBER 1-10, 1980
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

Map B.1-8: Vessel Activities September 1 to 10, 1980.

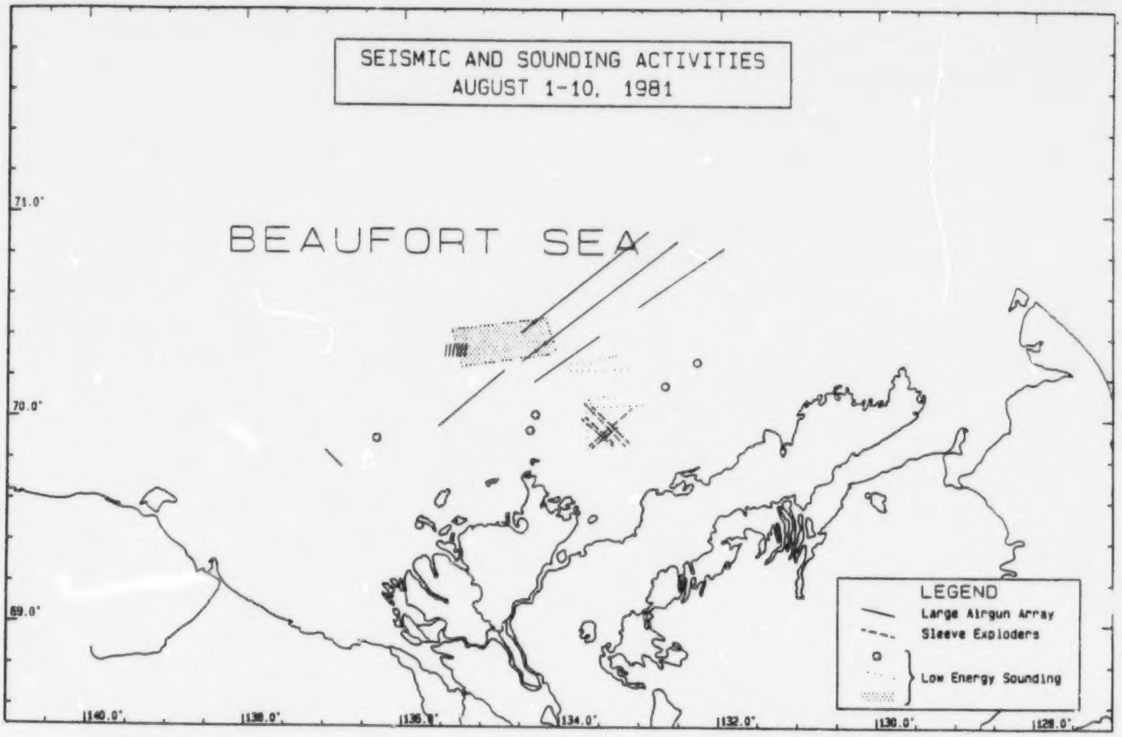
B.2 1981 INDUSTRIAL ACTIVITIES

The following section presents maps of:

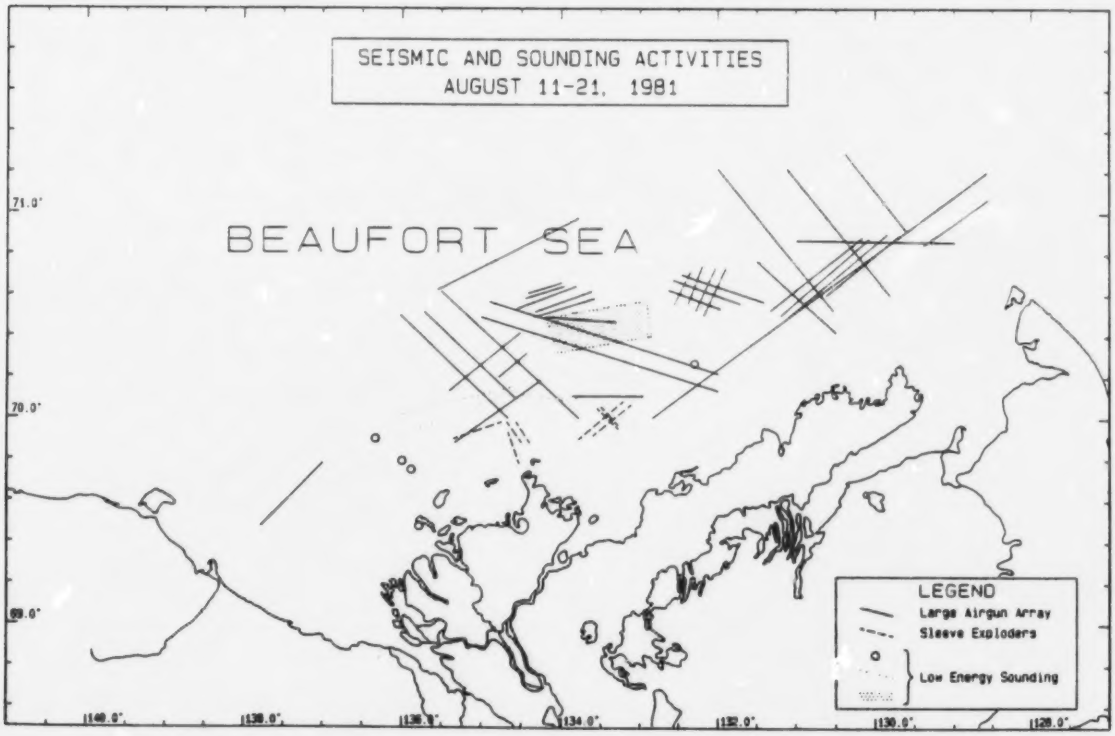
1) 1981 Seismic and Sounding Activities from July 22 to September 10,
2) 1981 Vessel Activities from July 22 to September 10, and
3) 1981 Helicopter Activities from July 22 to September 10.


SEISMIC AND SOUNDING ACTIVITIES
JULY 22-31, 1981
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Sleeve Exploders
Low Energy Sounding

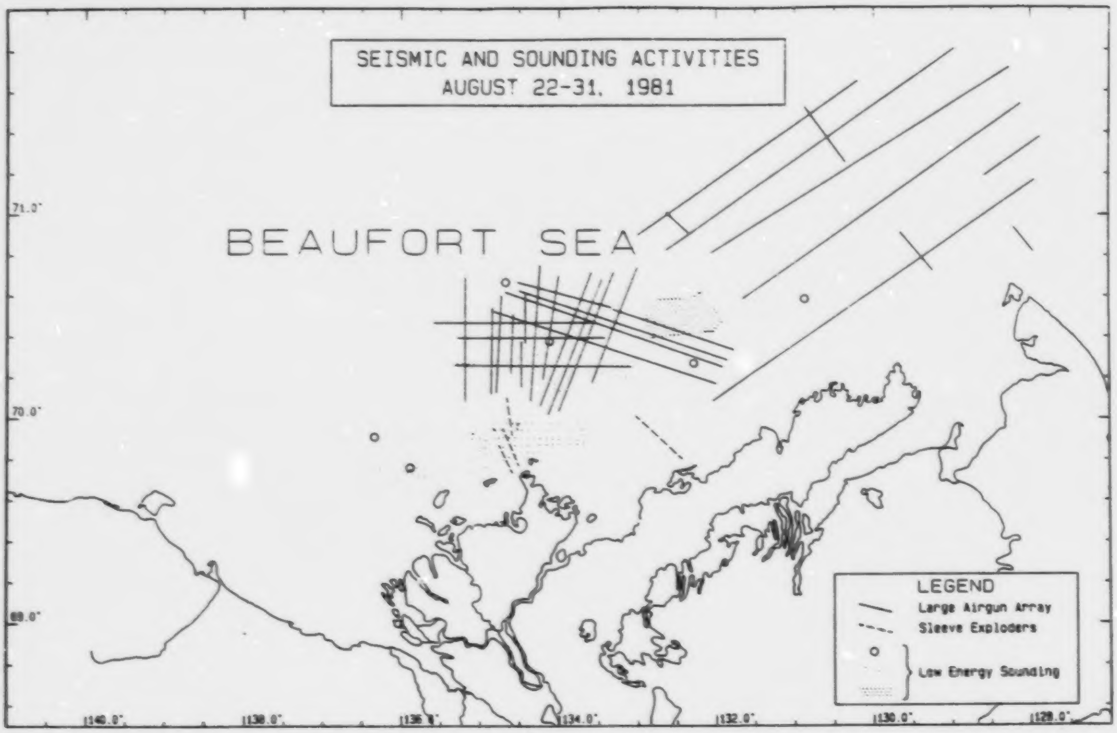
Map B.2-1: Seismic Activities July 22 to 31, 1981.


SEISMIC AND SOUNDING ACTIVITIES
AUGUST 1-10, 1981
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Sleeve Exploders
Low Energy Sounding

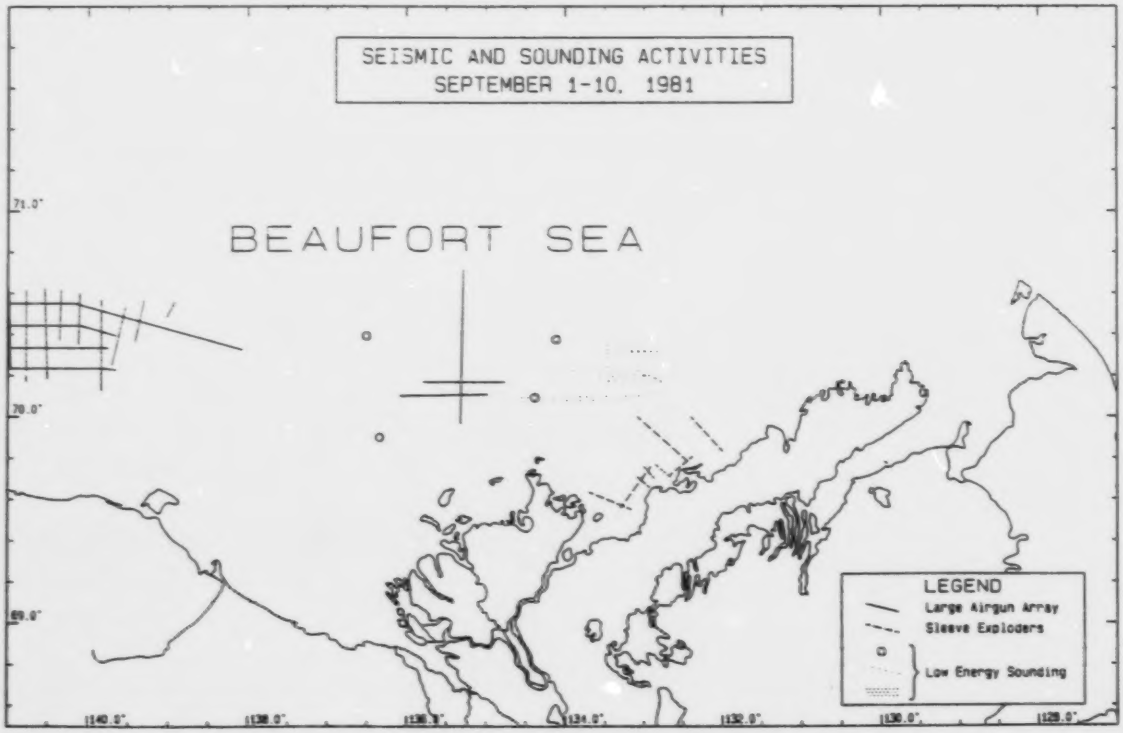
Map B.2-2: Seismic Activities August 1 to 10, 1981.


SEISMIC AND SOUNDING ACTIVITIES
AUGUST 11-21, 1981
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Sleeve Exploders
Low Energy Sounding

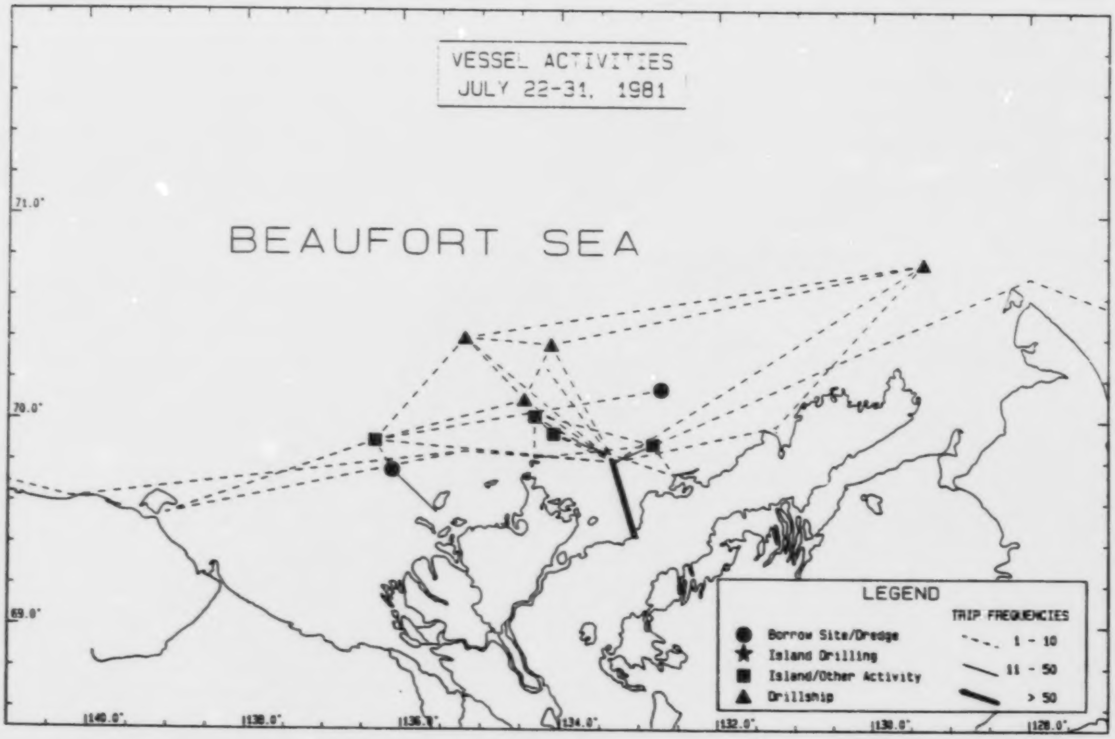
Map B.2-3: Seismic Activities August 11 to 21, 1981.


SEISMIC AND SOUNDING ACTIVITIES
AUGUST 22-31, 1981
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Sleeve Exploders
Low Energy Sounding

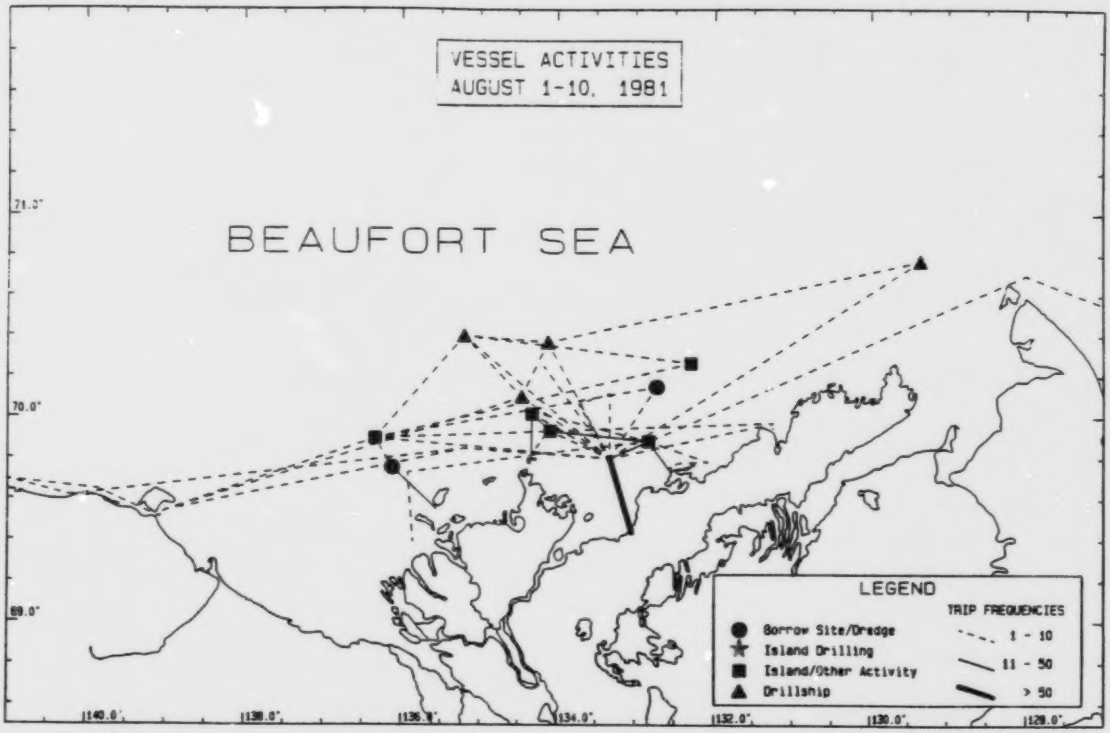
Map B.2-4: Seismic Activities August 22 to 31, 1981.


SEISMIC AND SOUNDING ACTIVITIES
SEPTEMBER 1-10, 1981
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Sleeve Exploders
Low Energy Sounding

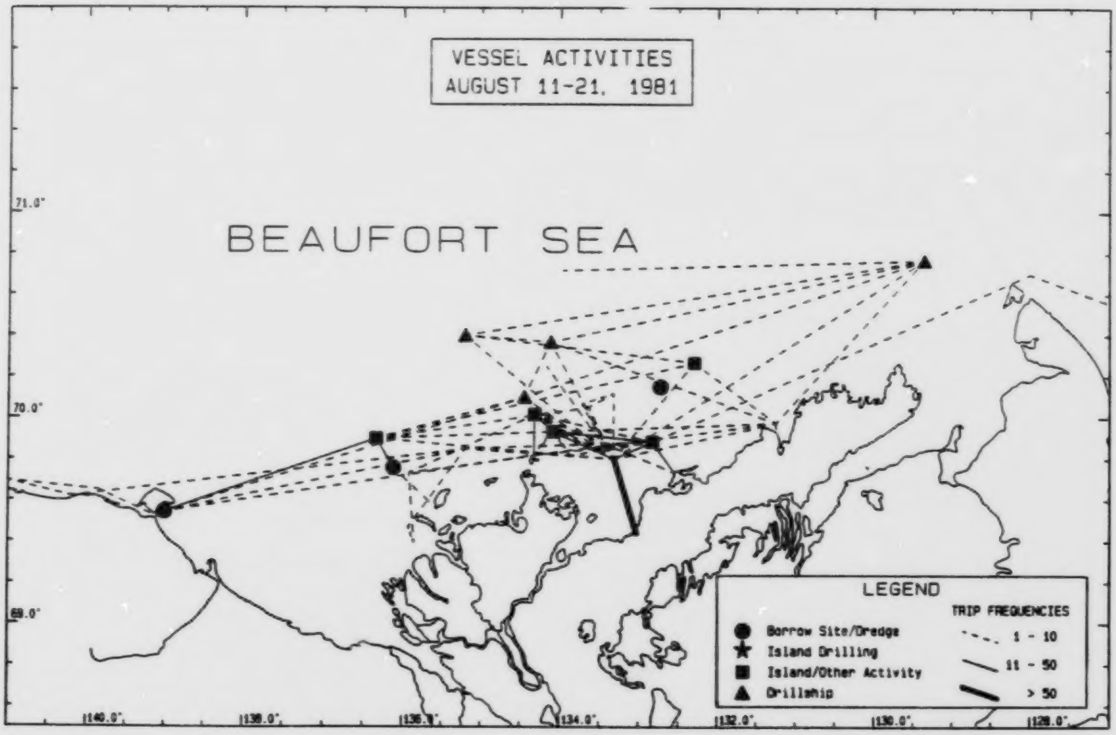
Map B.2-5: Seismic Activities September 1 to 10, 1981.


VESSEL ACTIVITIES
JULY 22-31, 1981
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
TRIP FREQUENCIES
1 - 10
11 - 50
> 50

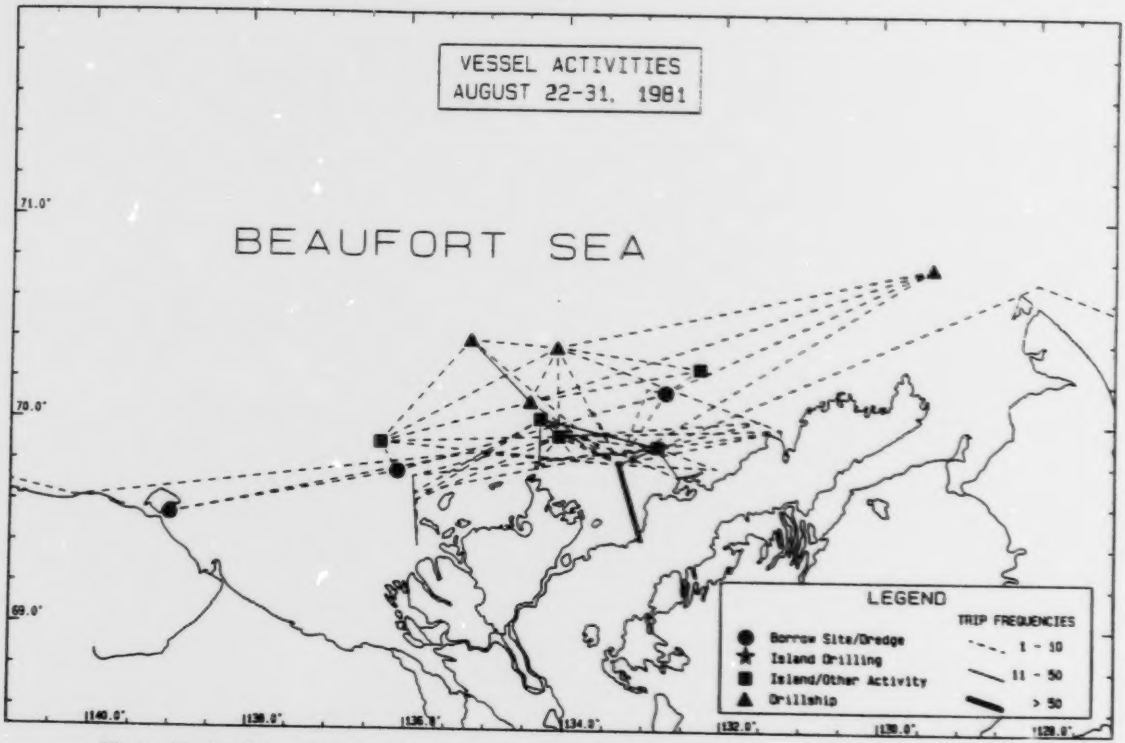
Map B.2-6: Vessel Activities July 22 to 31, 1981.


VESSEL ACTIVITIES
AUGUST 1-10, 1981
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

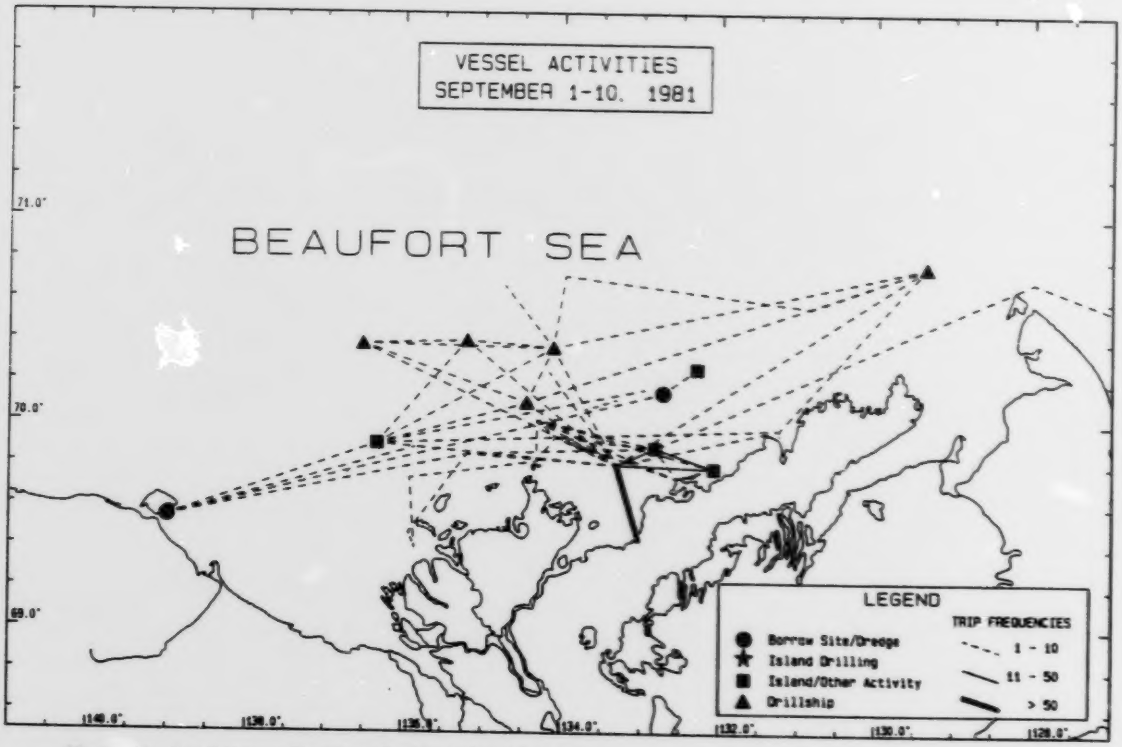
Map B.2-7: Vessel Activities August 1 to 10, 1981.


VESSEL ACTIVITIES
AUGUST 11-21, 1981
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

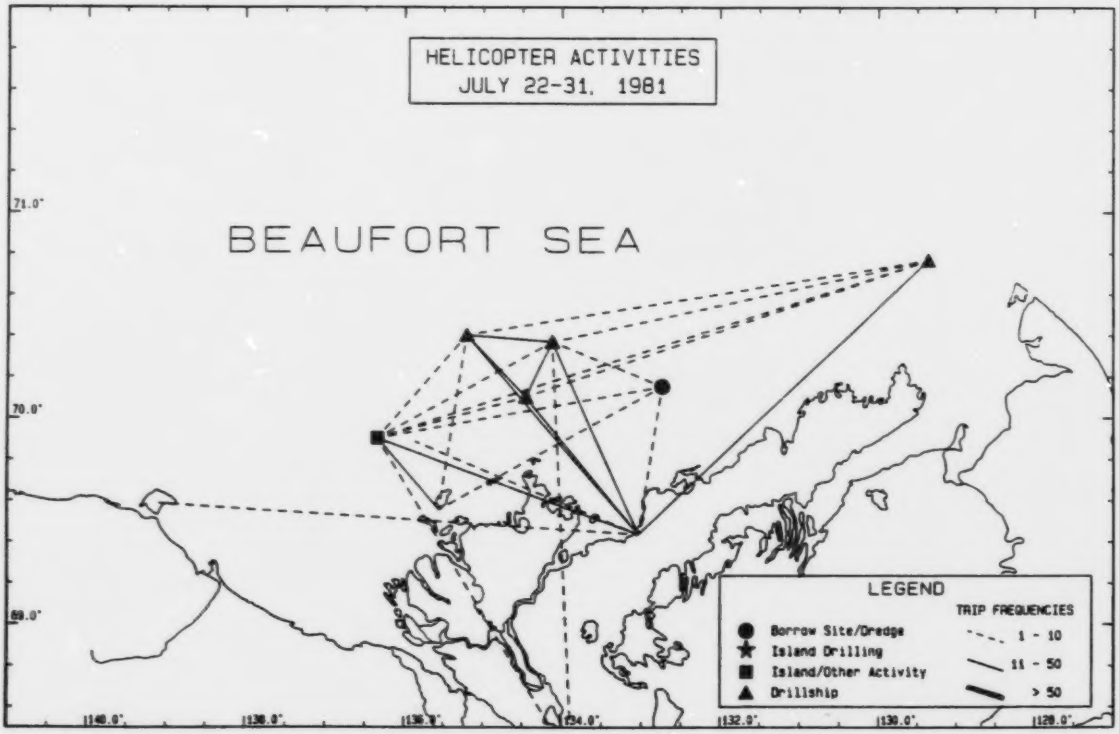
Map B.2-8: Vessel Activities August 11 to 21, 1981.


VESSEL ACTIVITIES
AUGUST 22-31, 1981
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

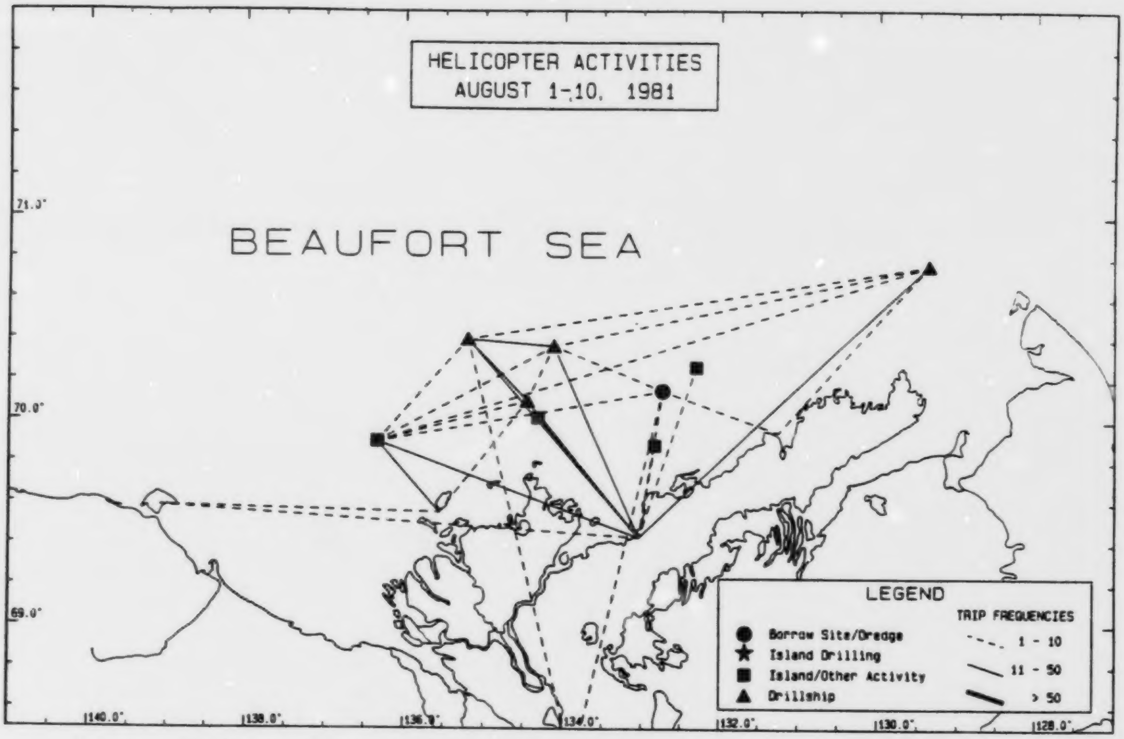
Map B.2-9: Vessel Activities August 22 to 31, 1981.


VESSEL ACTIVITIES
SEPTEMBER 1-10, 1981
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

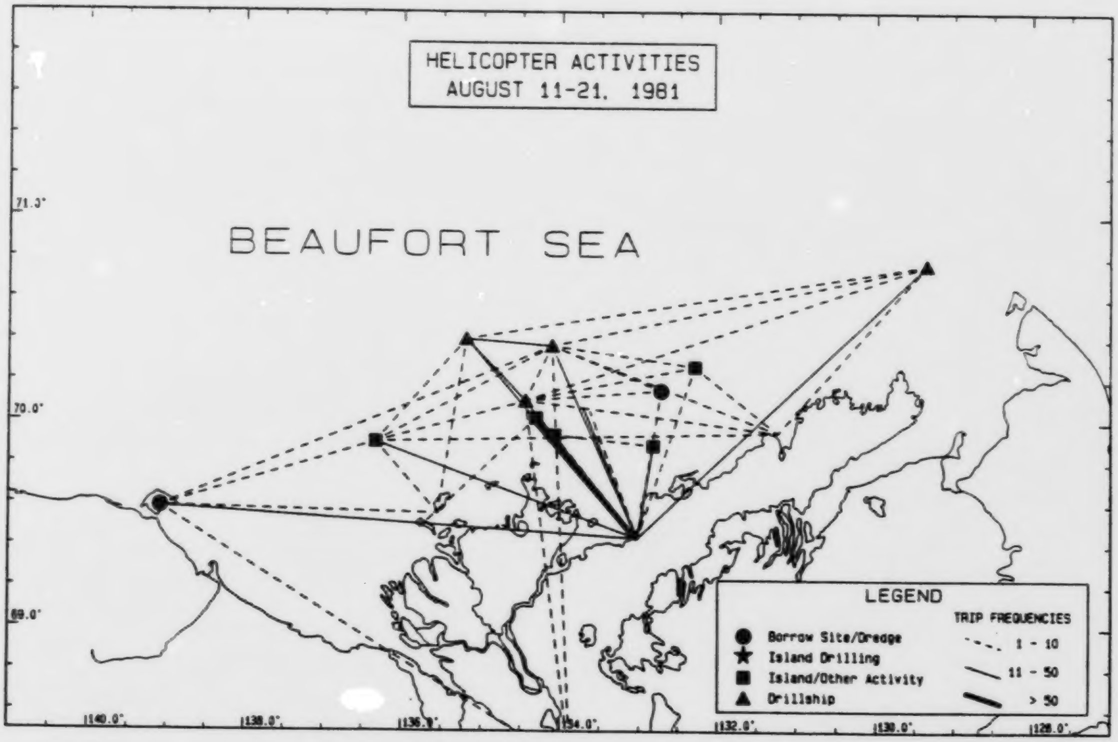
Map B.2-10: Vessel Activities September 1 to 10, 1981.


HELICOPTER ACTIVITIES
JULY 22-31, 1981
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

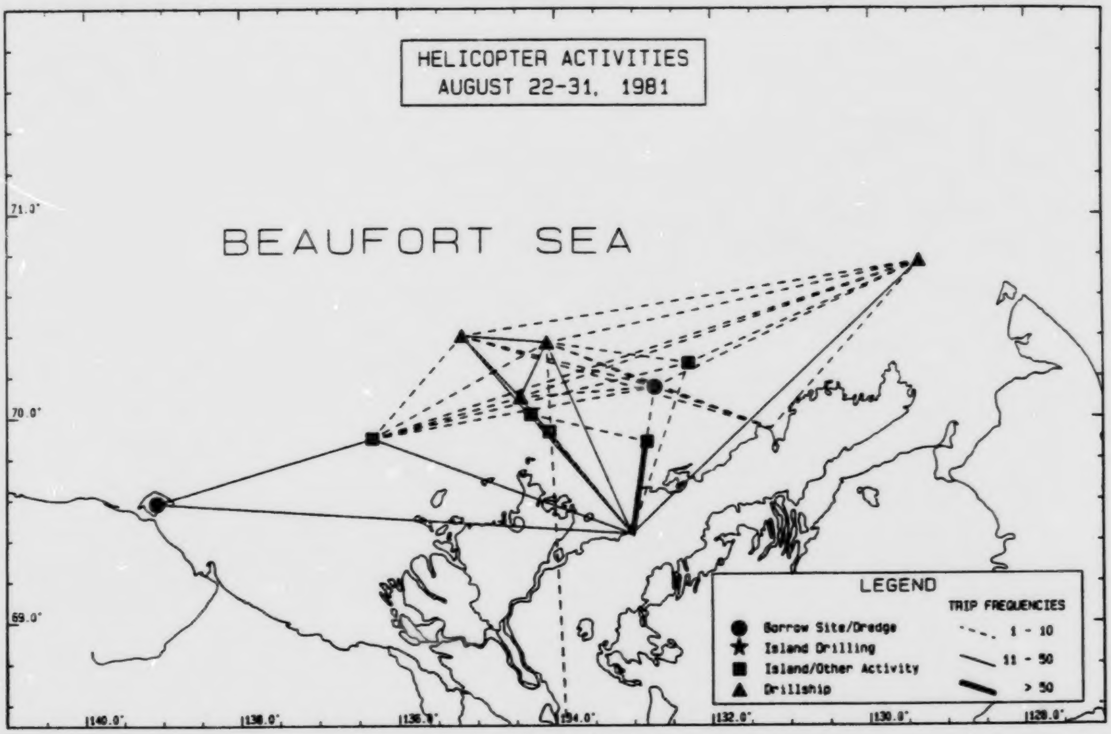
Map B.2-11: Helicopter Activities July 22 to 31, 1981.


HELICOPTER ACTIVITIES
AUGUST 1-10, 1981
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
TRIP FREQUENCIES
1 - 10
11 - 50
> 50

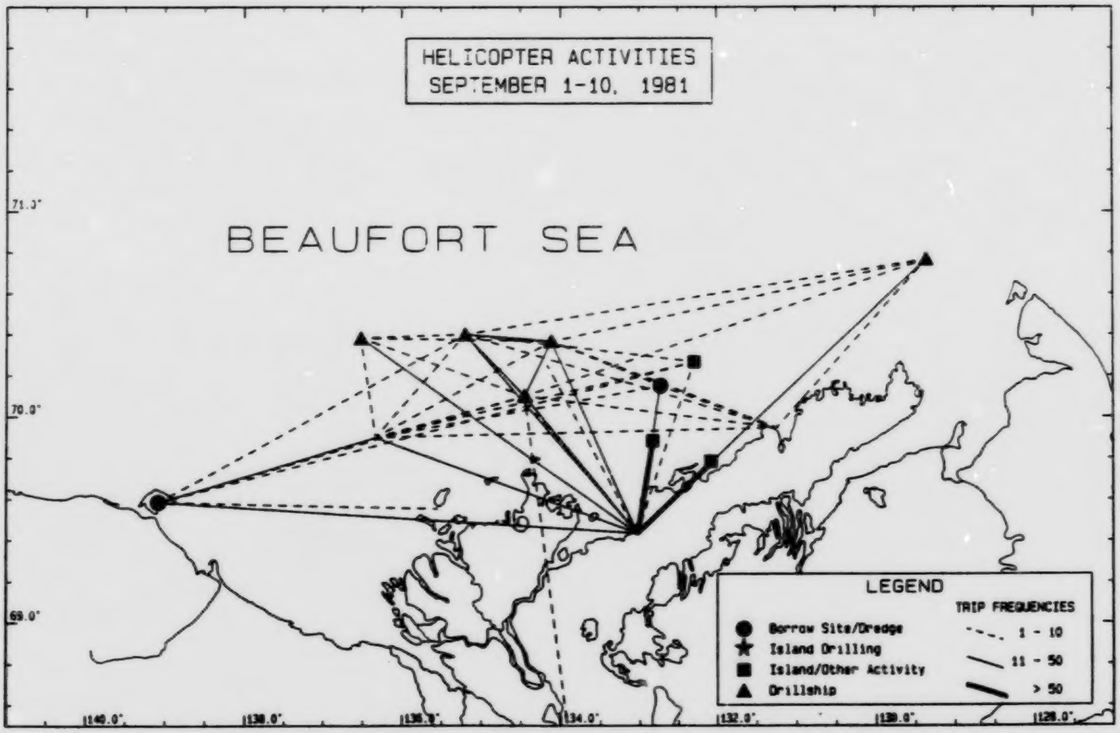
Map B.2-12: Helicopter Activities August 1 to 10, 1981.


HELICOPTER ACTIVITIES
AUGUST 11-21, 1981
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
TRIP FREQUENCIES
1 - 10
11 - 50
> 50

Map B.2-13: Helicopter Activities August 11 to 21, 1981.


HELICOPTER ACTIVITIES
AUGUST 22-31, 1981
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

Map B.2-14: Helicopter Activities August 22 to 31, 1981.

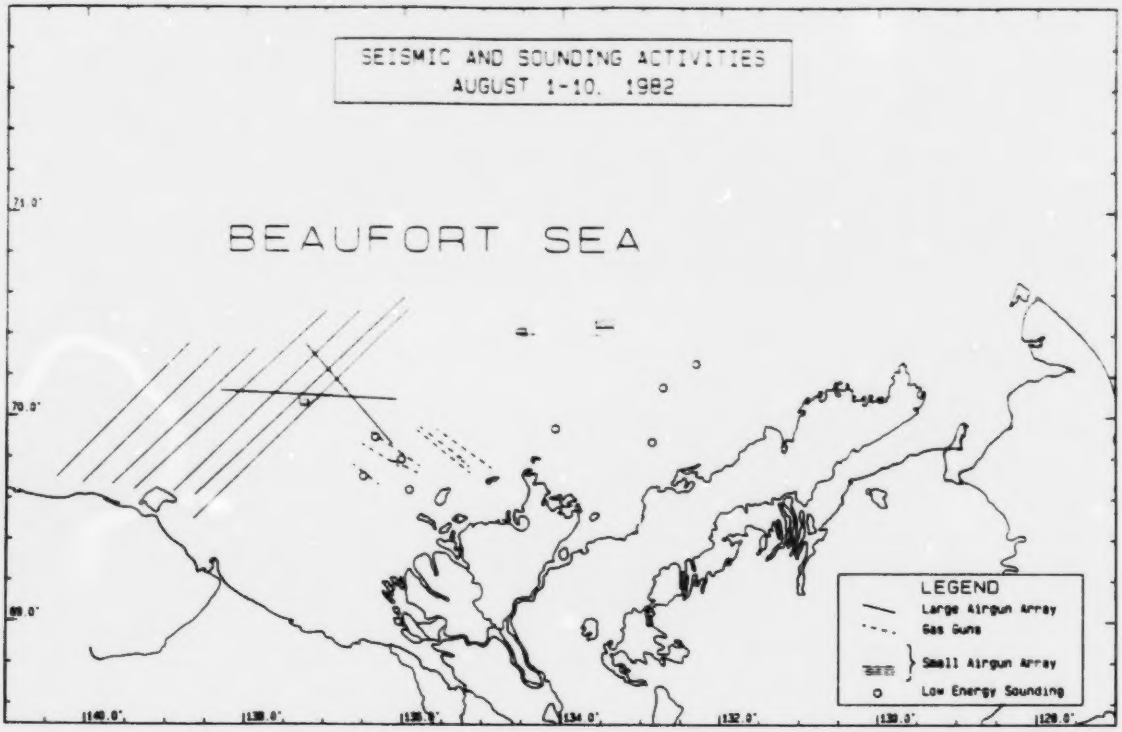

HELICOPTER ACTIVITIES
SEPTEMBER 1-10, 1981
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

Map B.2-15: Helicopter Activities September 1 to 10, 1981.

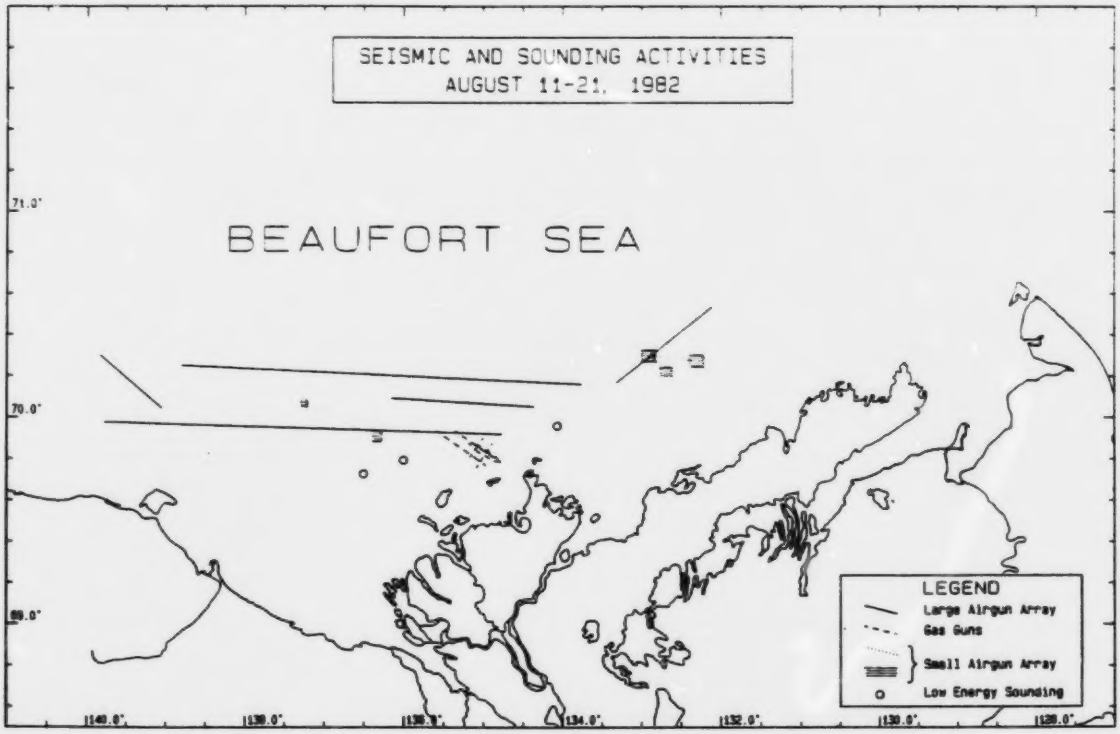
B.3 1982 INDUSTRIAL ACTIVITIES

The following section presents maps of:

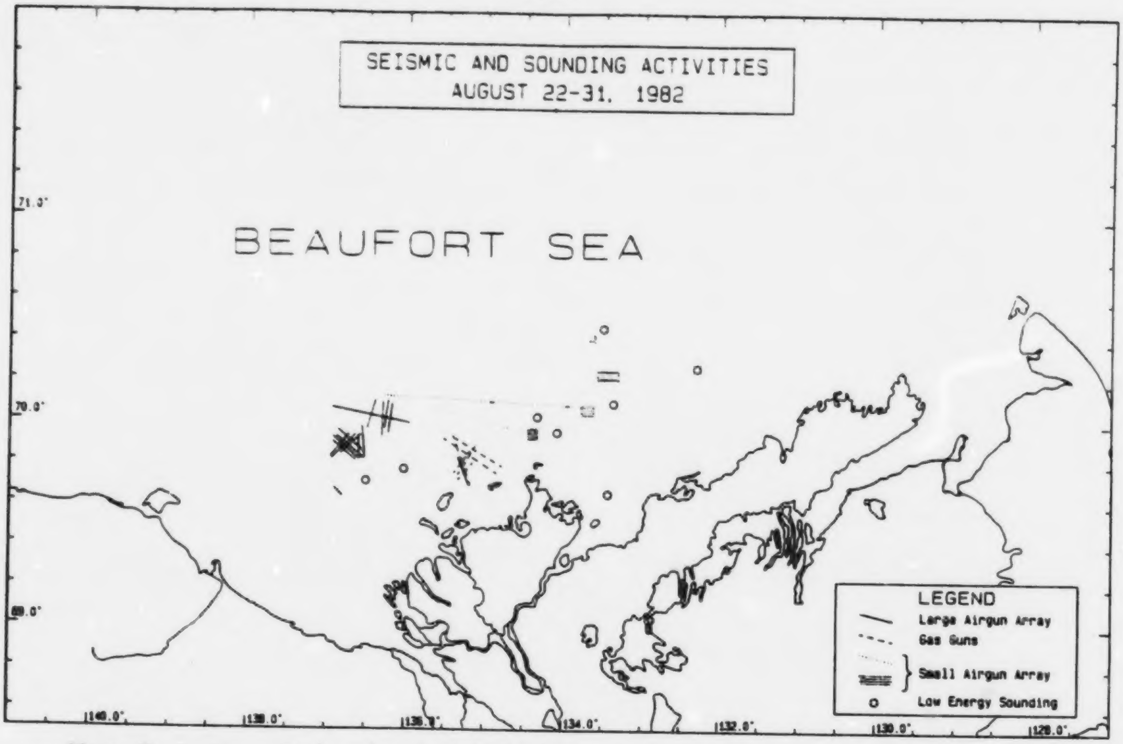
1) 1982 Seismic and Sounding Activities from August 1 to September 10,
2) 1982 Vessel Activities from August 1 to September 10, and
3) 1982 Helicopter Activities from August 1 to September 10.


SEISMIC AND SOUNDING ACTIVITIES
AUGUST 1-10, 1982
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Gas Guns
Small Airgun Array
Low Energy Sounding

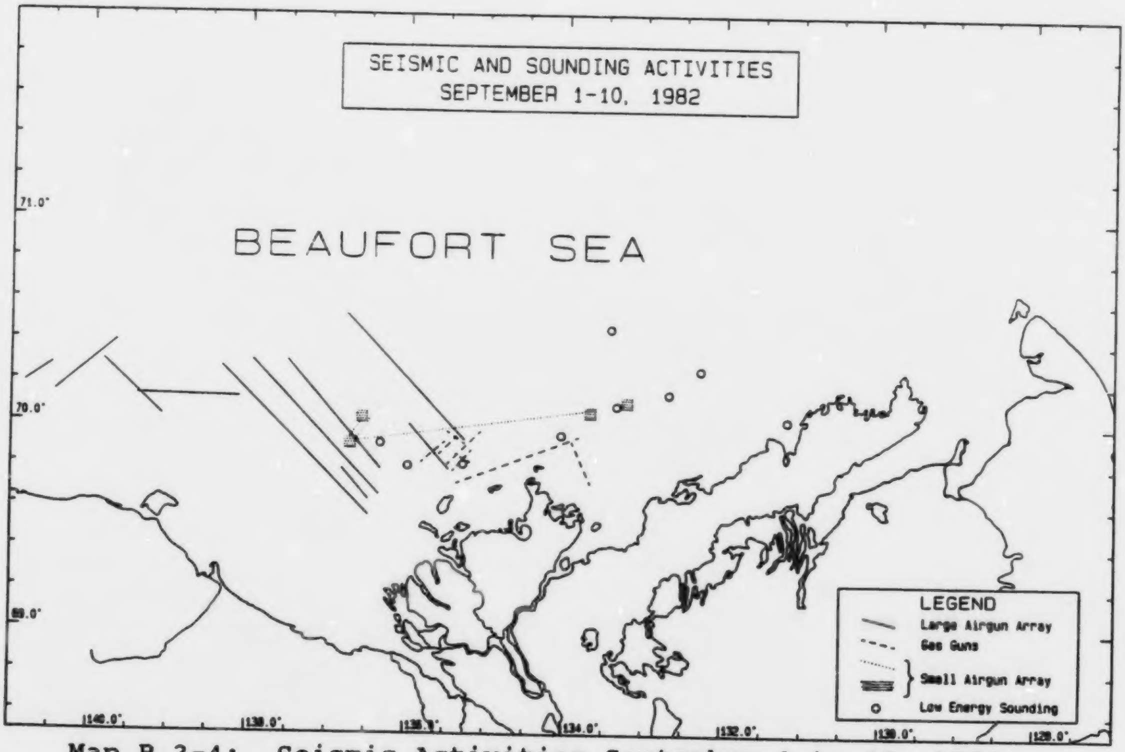
Map B.3-1: Seismic Activities August 1 to 10, 1982.


SEISMIC AND SOUNDING ACTIVITIES
AUGUST 11-21, 1982
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Gas Guns
Small Airgun Array
Low Energy Sounding

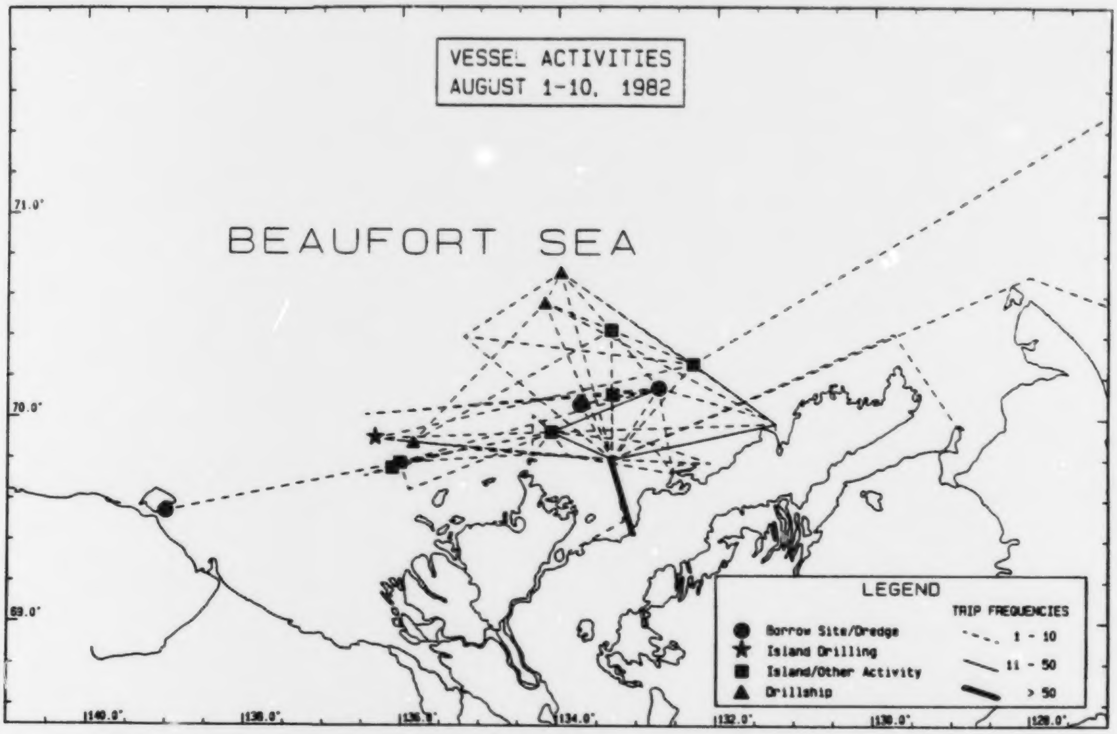
Map B.3-2: Seismic Activities August 11 to 21, 1982.


SEISMIC AND SOUNDING ACTIVITIES
AUGUST 22-31, 1982
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Gas Guns
Small Airgun Array
Low Energy Sounding

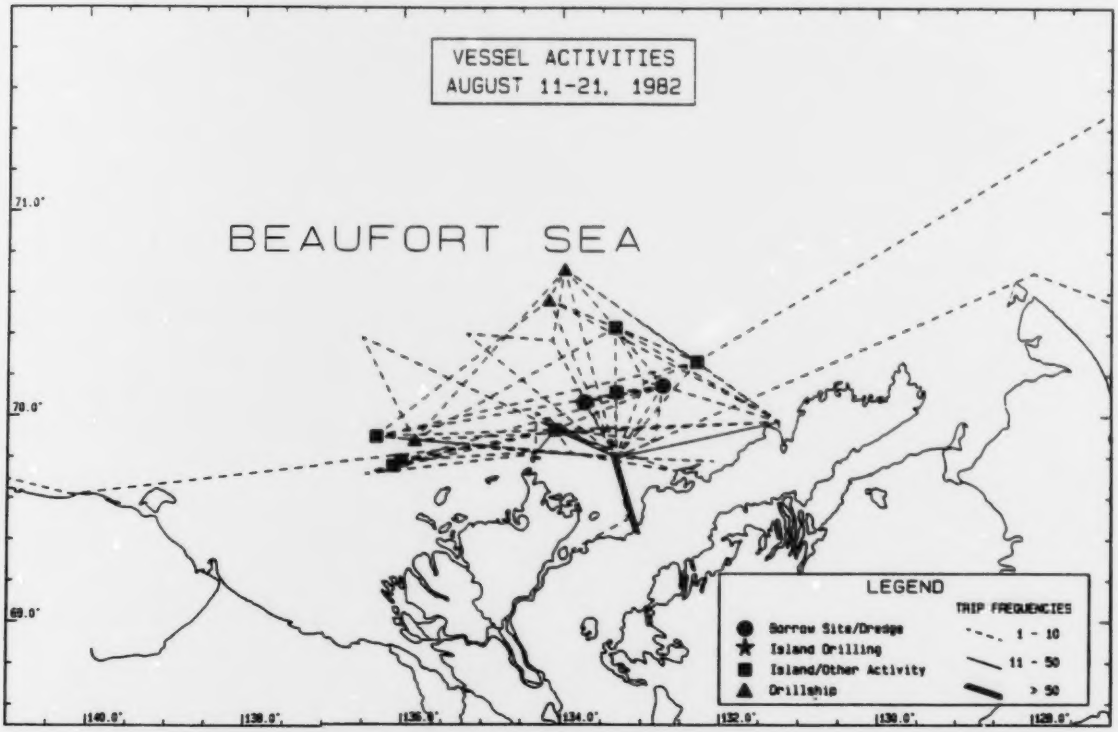
Map B.3-3: Seismic Activities August 22 to 31, 1982.


SEISMIC AND SOUNDING ACTIVITIES
SEPTEMBER 1-10, 1982
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Gas Guns
Small Airgun Array
Low Energy Sounding

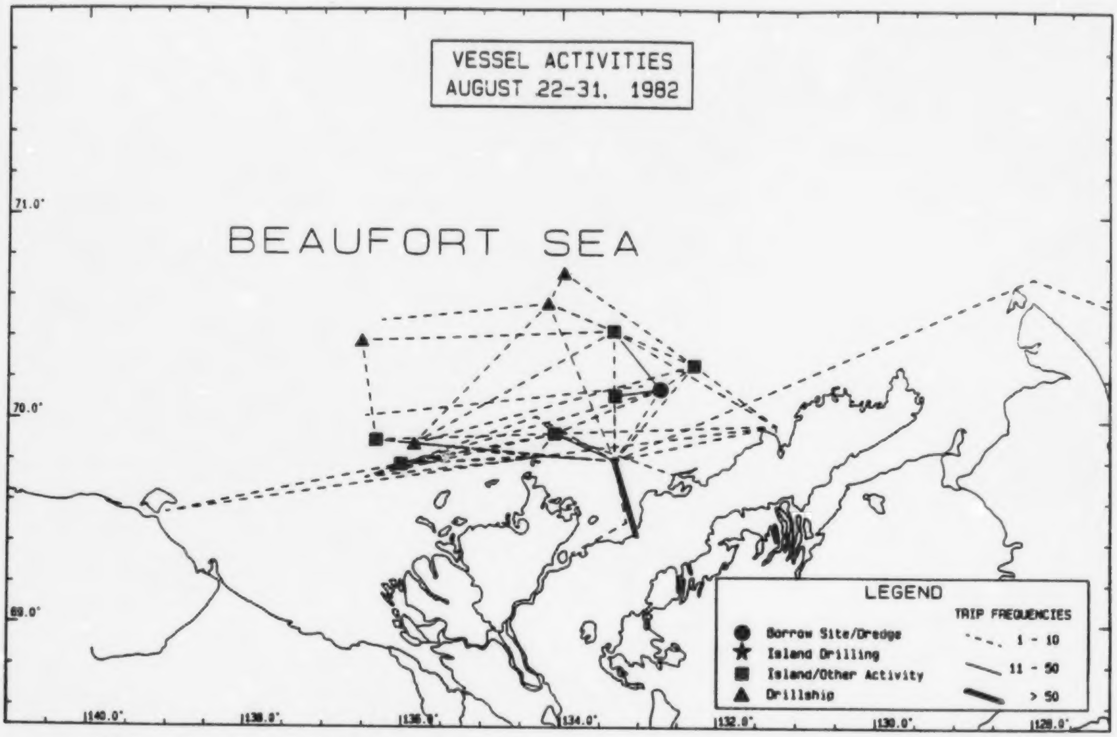
Map B.3-4: Seismic Activities September 1 to 10, 1982.


VESSEL ACTIVITIES
AUGUST 1-10, 1982
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

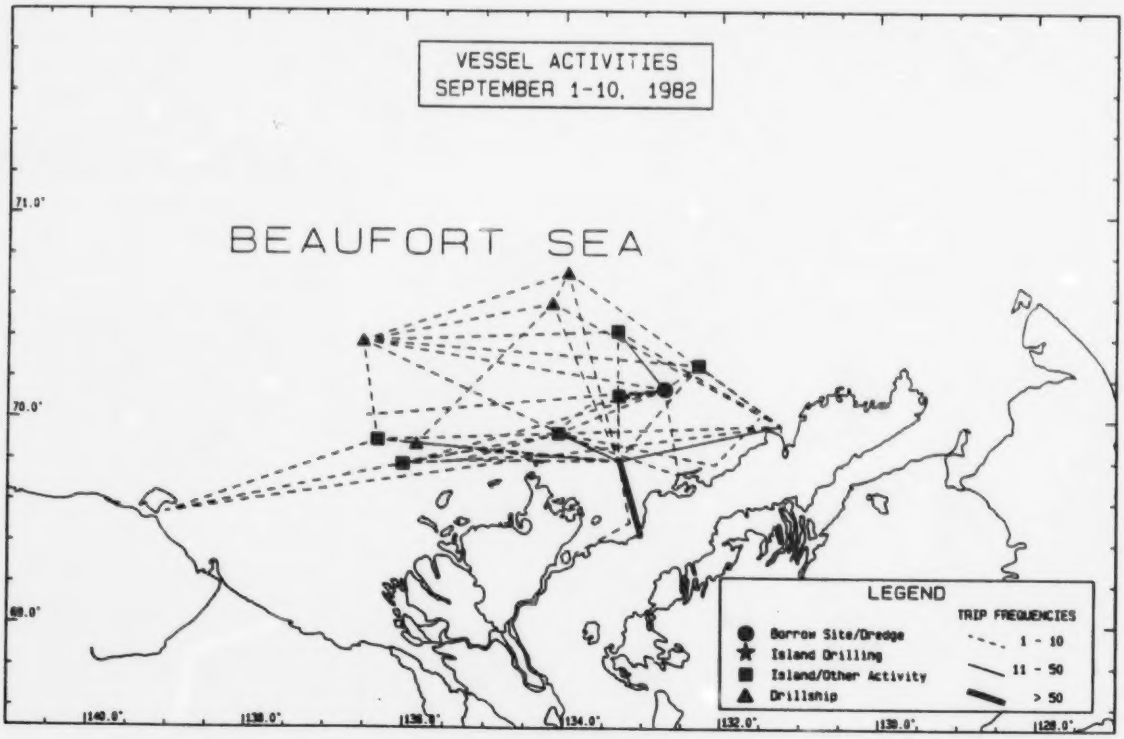
Map B.3-5: Vessel Activities August 1 to 10, 1982.


VESSEL ACTIVITIES
AUGUST 11-21, 1982
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

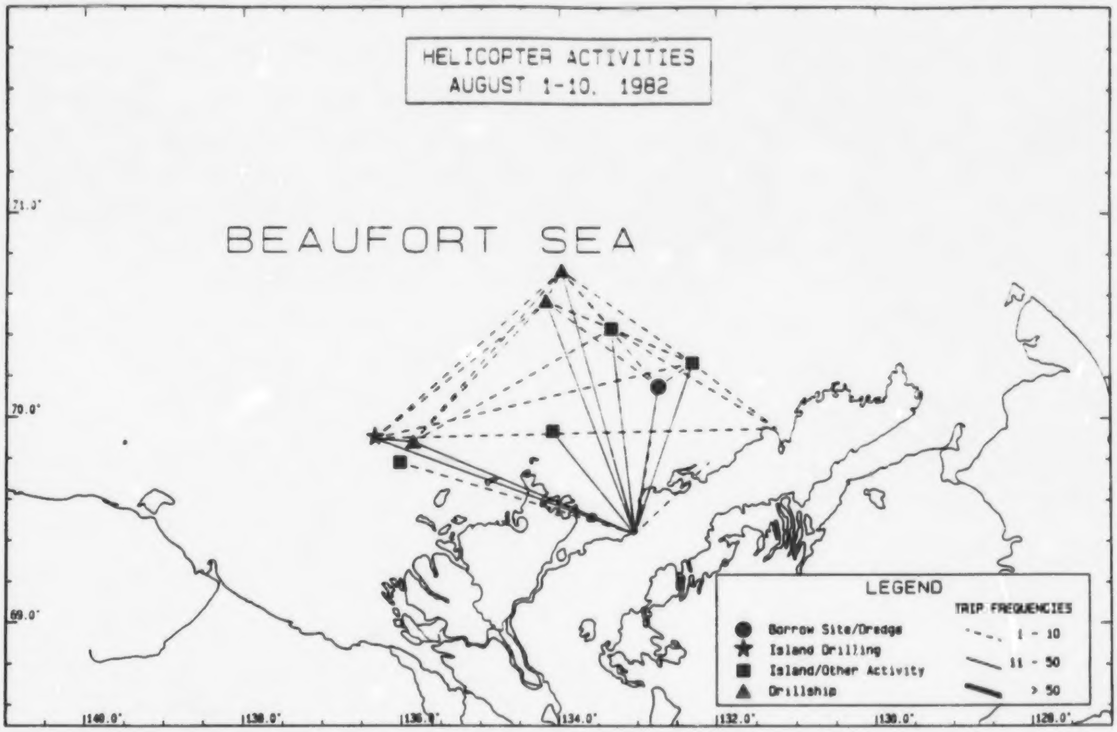
Map B.3-6: Vessel Activities August 11 to 21, 1982.


VESSEL ACTIVITIES
AUGUST 22-31, 1982
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

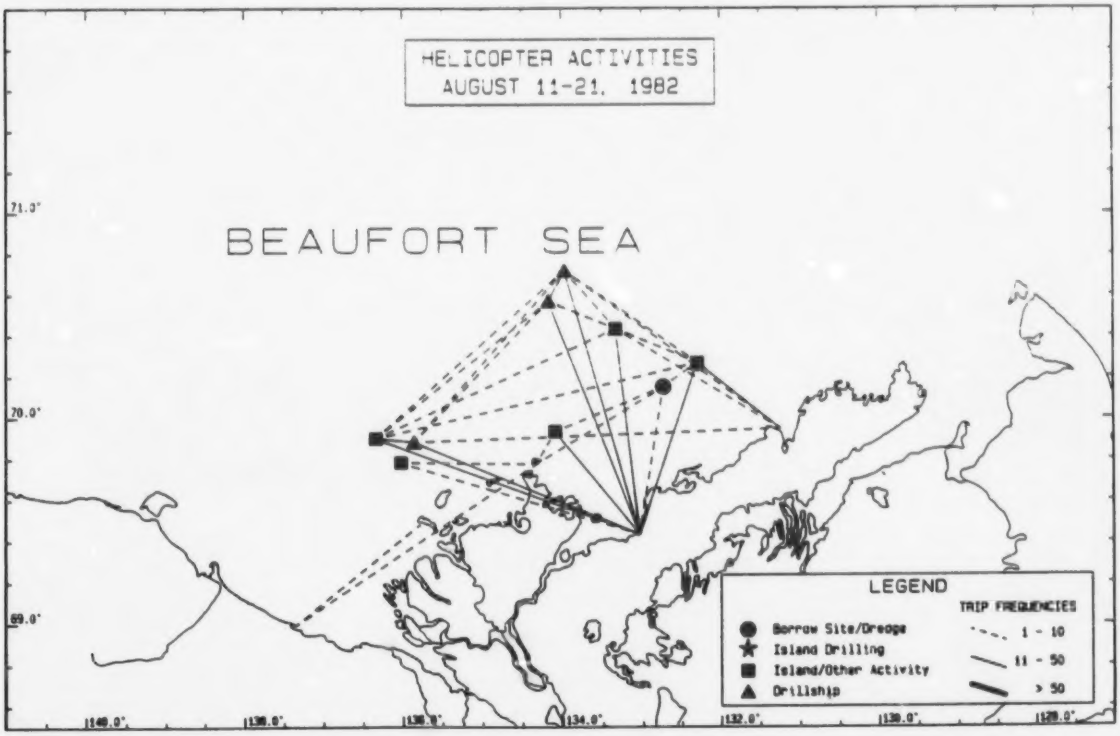
Map B.3-7: Vessel Activities August 22 to 31, 1982.


VESSEL ACTIVITIES
SEPTEMBER 1-10, 1982
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

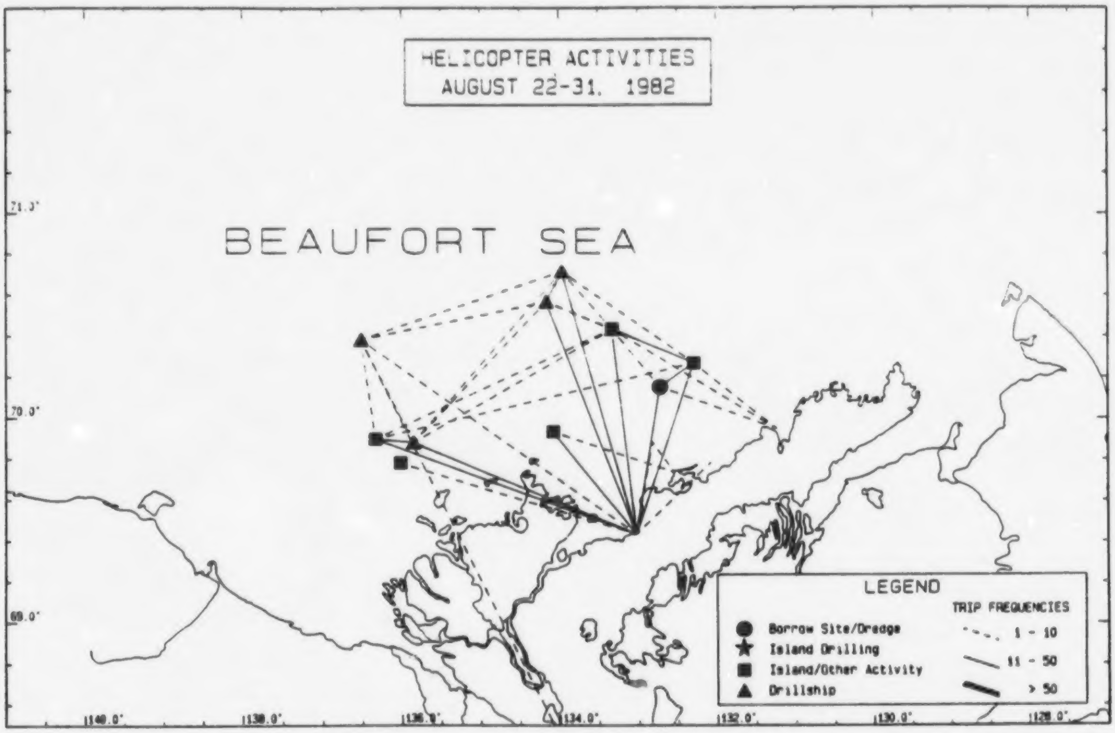
Map B.3-8: Vessel Activities September 1 to 10, 1982.


HELICOPTER ACTIVITIES
AUGUST 1-10, 1982
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

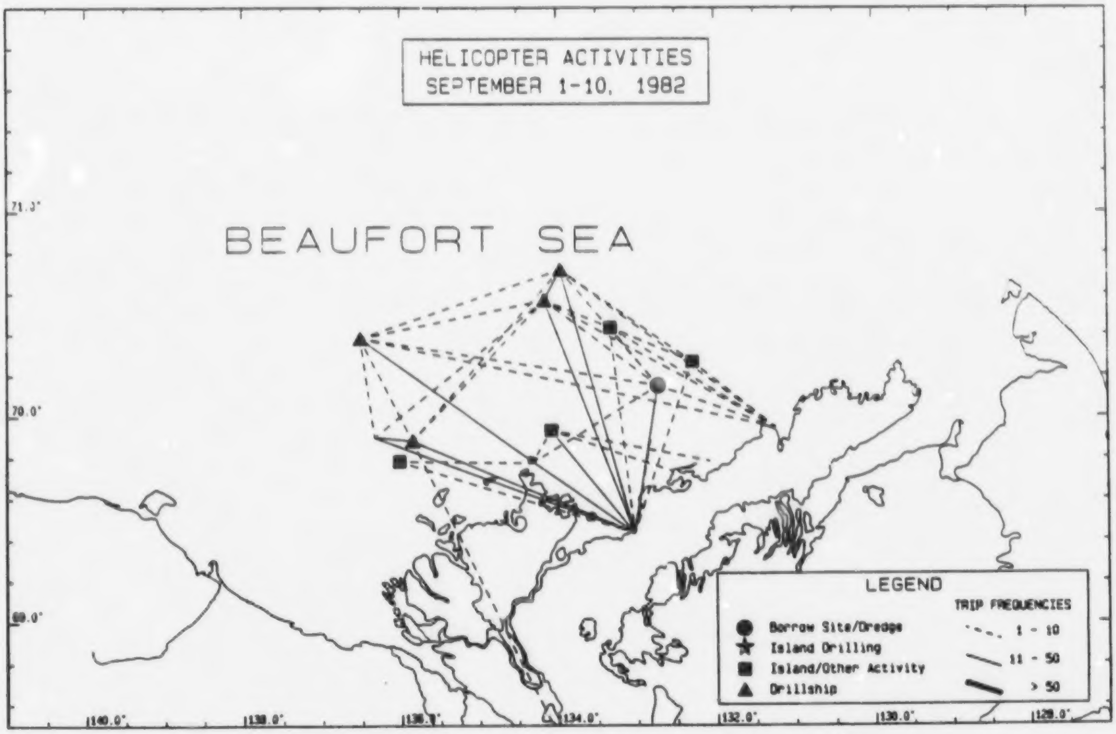
Map B.3-9: Helicopter Activities August 1 to 10, 1982.


HELICOPTER ACTIVITIES
AUGUST 11-21, 1982
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

Map B.3-10: Helicopter Activities August 11 to 21, 1982.


HELICOPTER ACTIVITIES
AUGUST 22-31, 1982
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

Map B.3-11: Helicopter Activities August 22 to 31, 1982.

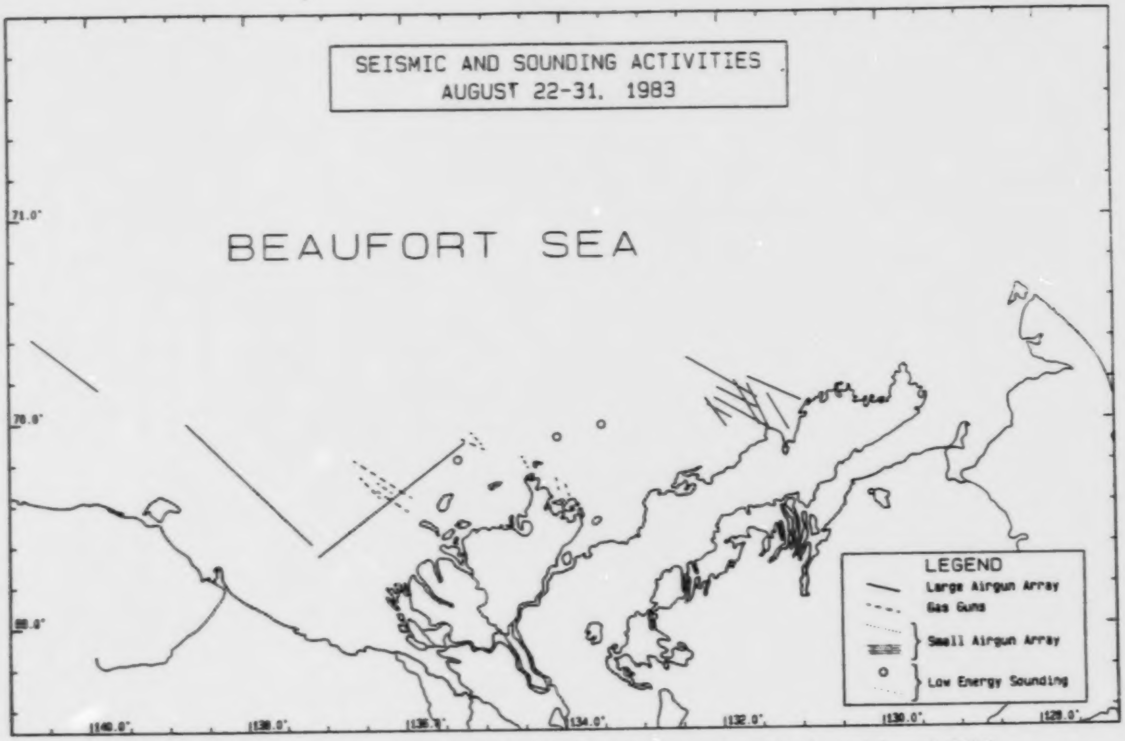

HELICOPTER ACTIVITIES
SEPTEMBER 1-10, 1982
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

Map B.3-12: Helicopter Activities September 1 to 10, 1982.

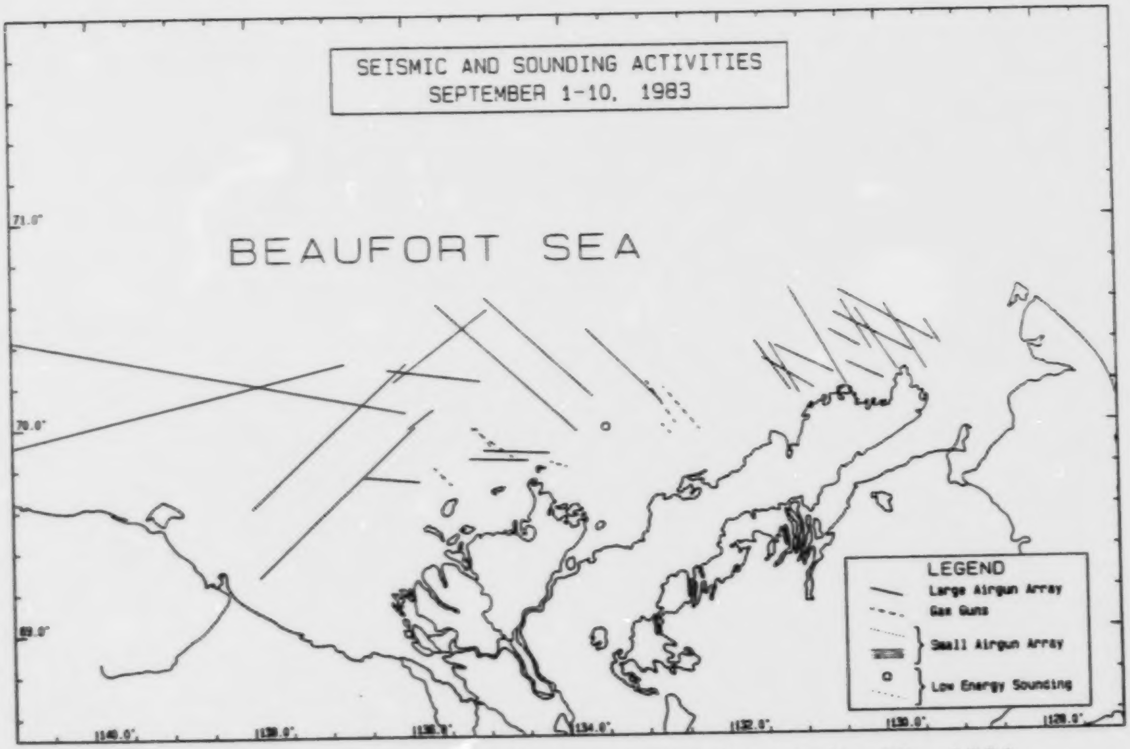
B.4 1983 INDUSTRIAL ACTIVITIES

The following section presents maps of:

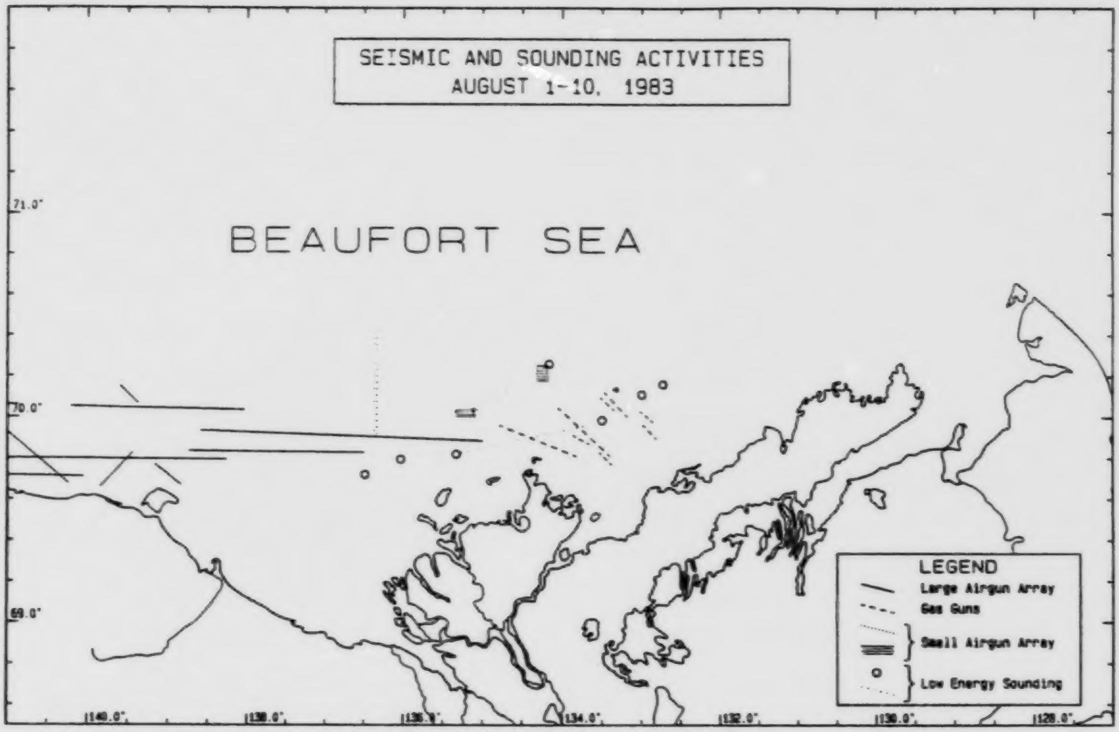
1) 1983 Seismic and Sounding Activities from August 1 to September 10,
2) 1983 Vessel Activities from August 1 to September 10, and
3) 1983 Helicopter Activities from August 1 to September 10.


SEISMIC AND SOUNDING ACTIVITIES
AUGUST 22-31, 1983
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Gas Guns
Small Airgun Array
Low Energy Sounding

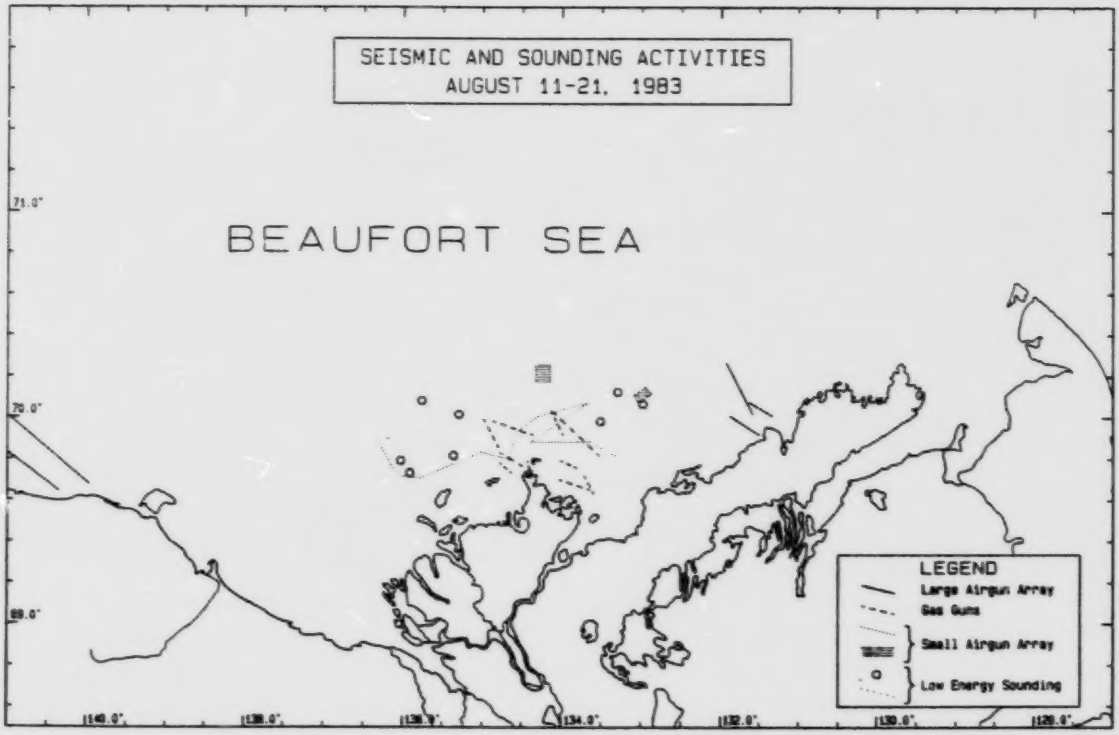
Map B.4-3: Seismic Activities August 22 to 31, 1983.


SEISMIC AND SOUNDING ACTIVITIES
SEPTEMBER 1-10, 1983
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Gas Guns
Small Airgun Array
Low Energy Sounding

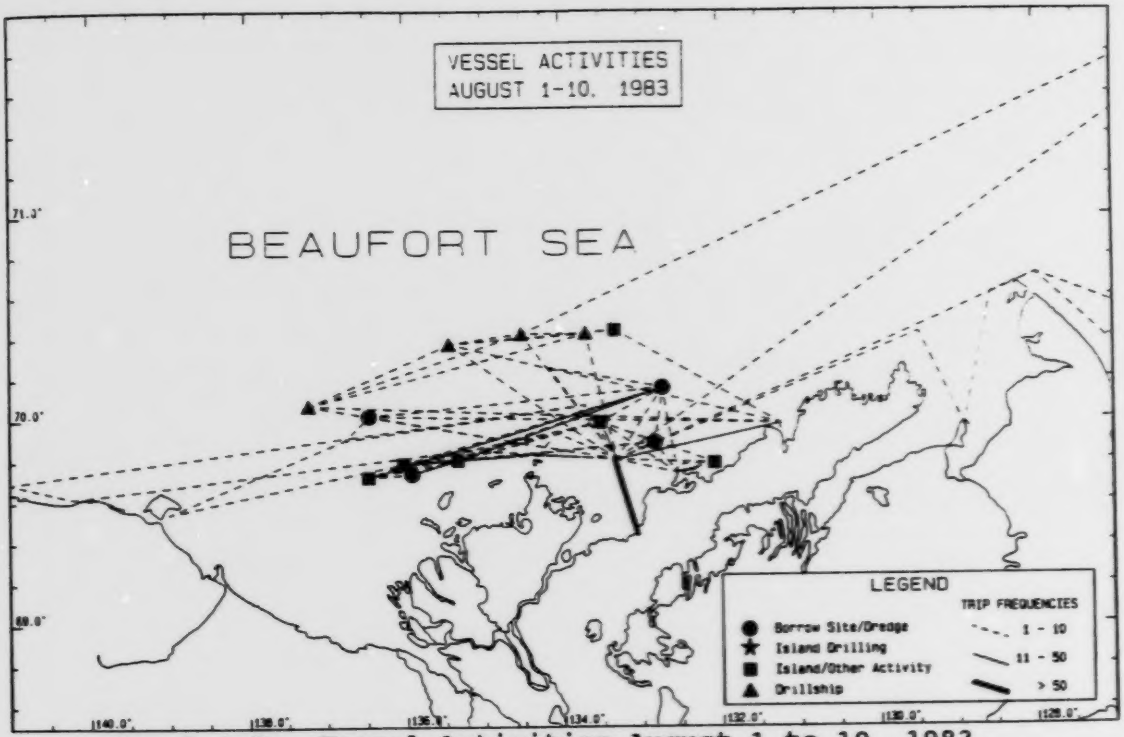
Map B.4-4: Seismic Activities September 1 to 10, 1983.


SEISMIC AND SOUNDING ACTIVITIES
AUGUST 1-10, 1983
71.0°
BEAUFORT SEA
70.0°
69.0°
LEGEND
Large Airgun Array
Gas Guns
Small Airgun Array
Low Energy Sounding
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

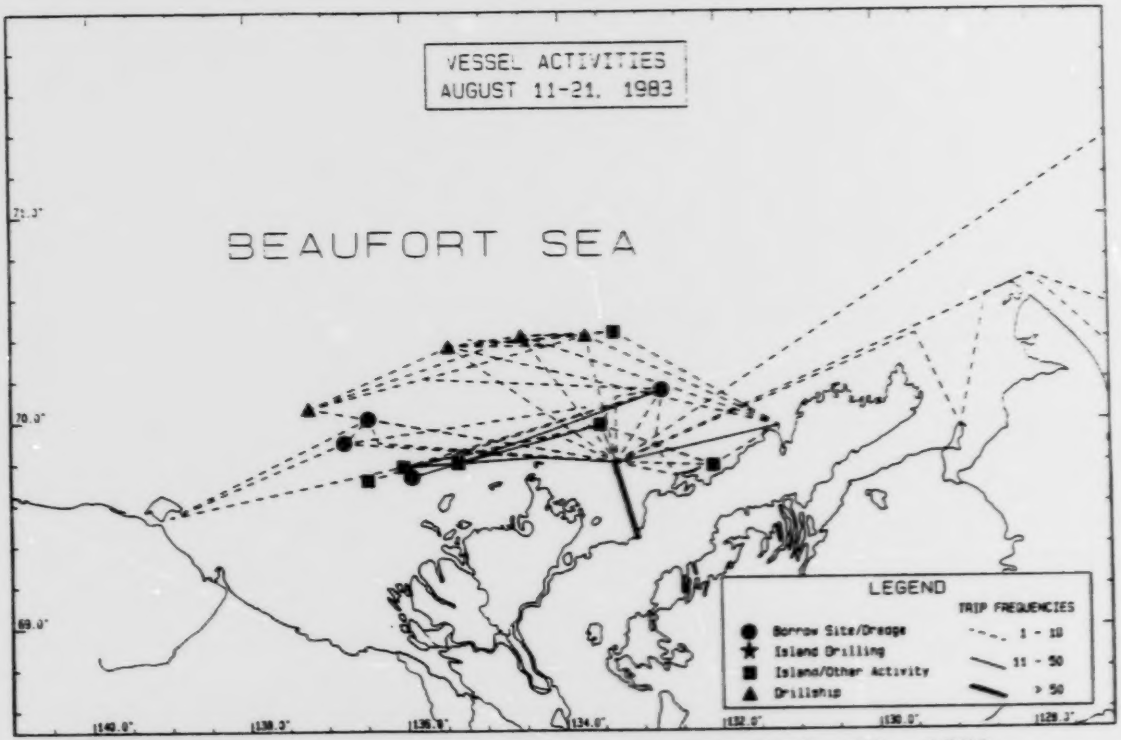
Map B.4-1: Seismic Activities August 1 to 10, 1983.


SEISMIC AND SOUNDING ACTIVITIES
AUGUST 11-21, 1983
71.0°
BEAUFORT SEA
70.0°
69.0°
LEGEND
Large Airgun Array
Gas Guns
Small Airgun Array
Low Energy Sounding
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

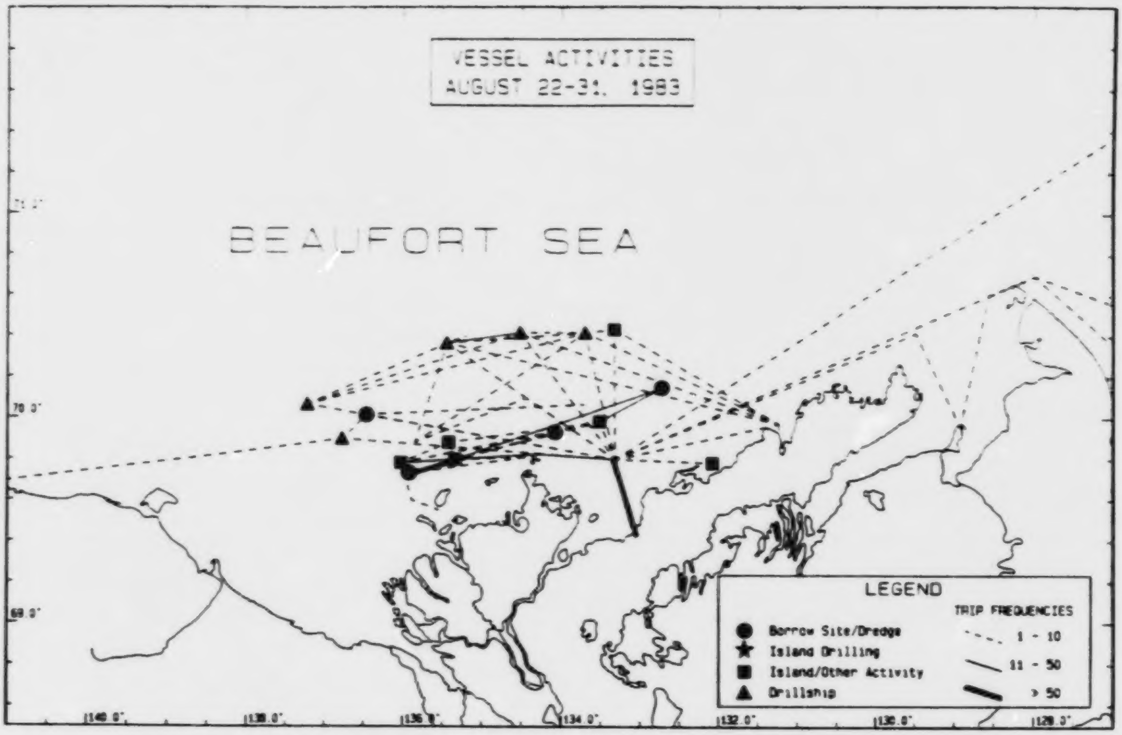
Map B.4-2: Seismic Activities August 11 to 21, 1983.


VESSEL ACTIVITIES
AUGUST 1-10, 1983
BEAUFORT SEA
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

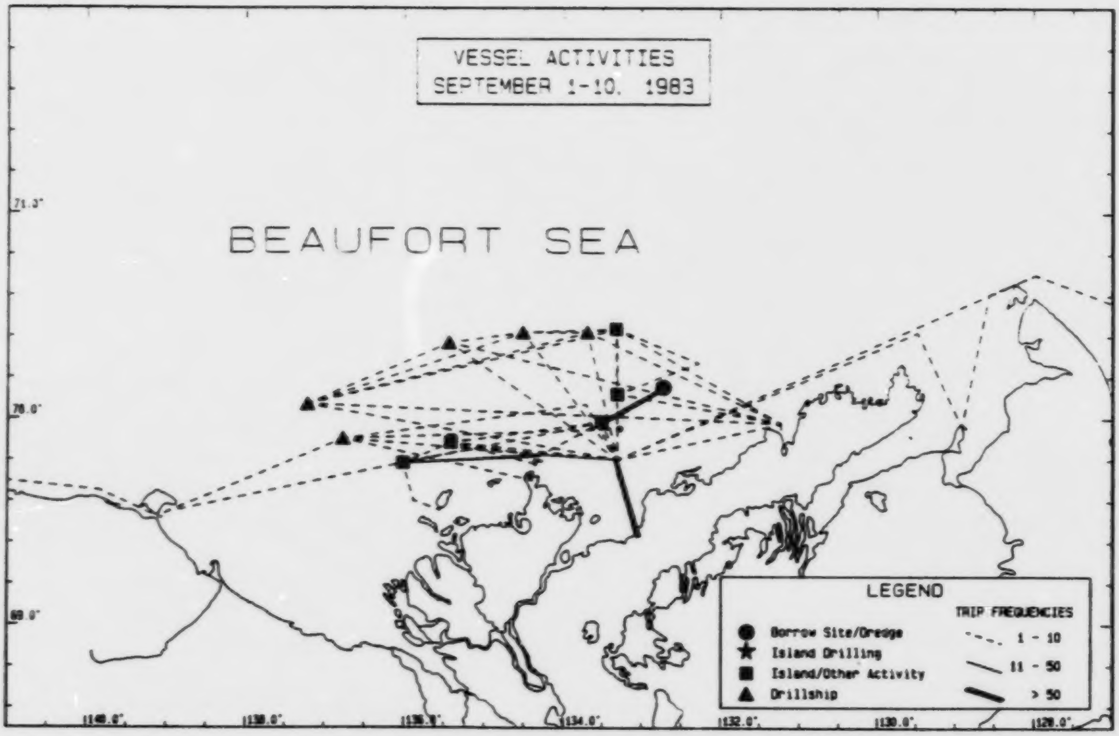
Map B.4-5: Vessel Activities August 1 to 10, 1983.


VESSEL ACTIVITIES
AUGUST 11-21, 1983
BEAUFORT SEA
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

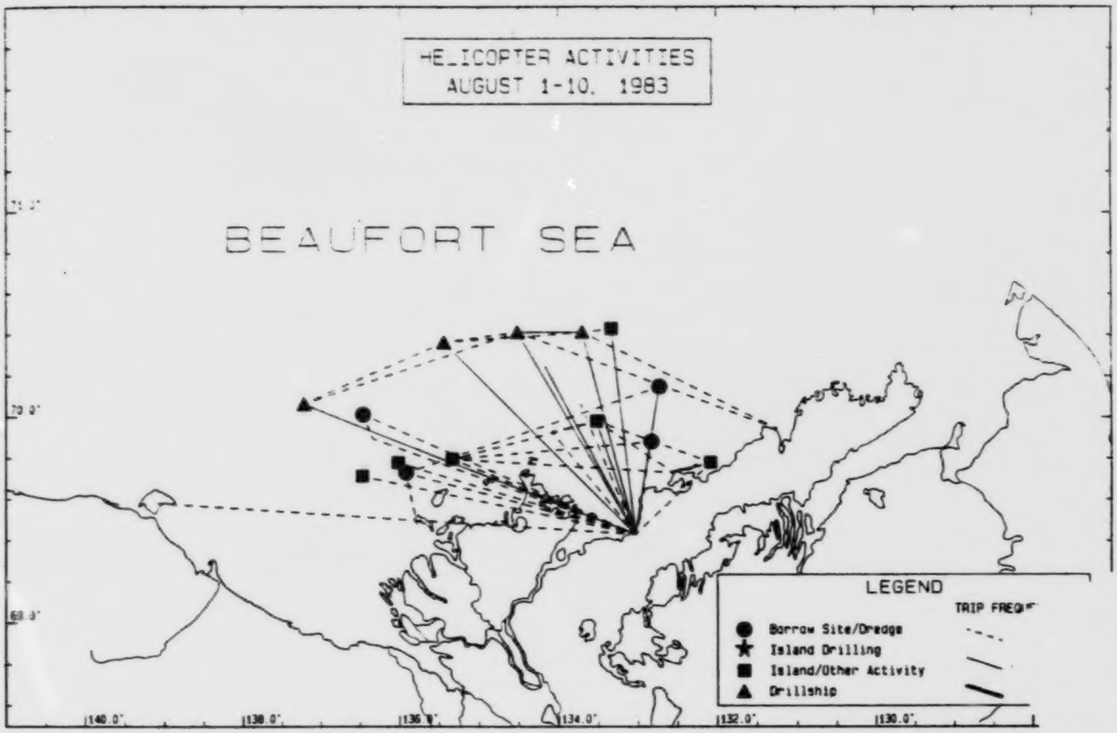
Map B.4-6: Vessel Activities August 11 to 21, 1983.


VESSEL ACTIVITIES
AUGUST 22-31, 1983
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

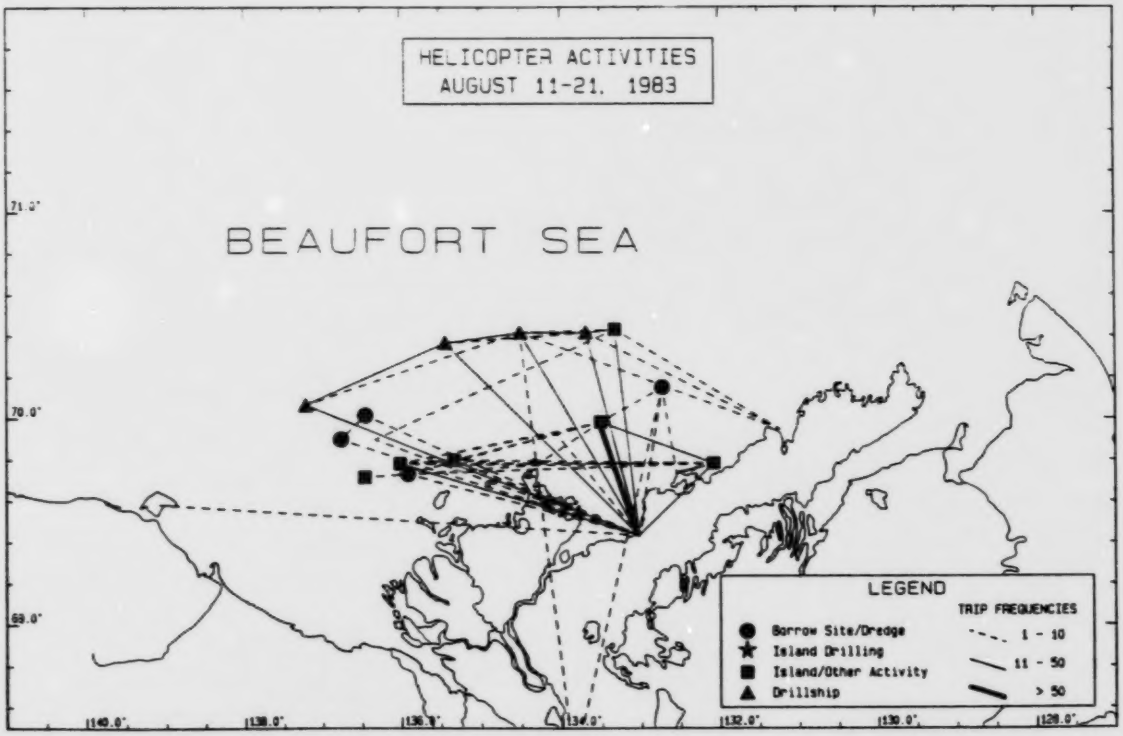
Map B.4-7: Vessel Activities August 22 to 31, 1983.


VESSEL ACTIVITIES
SEPTEMBER 1-10, 1983
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

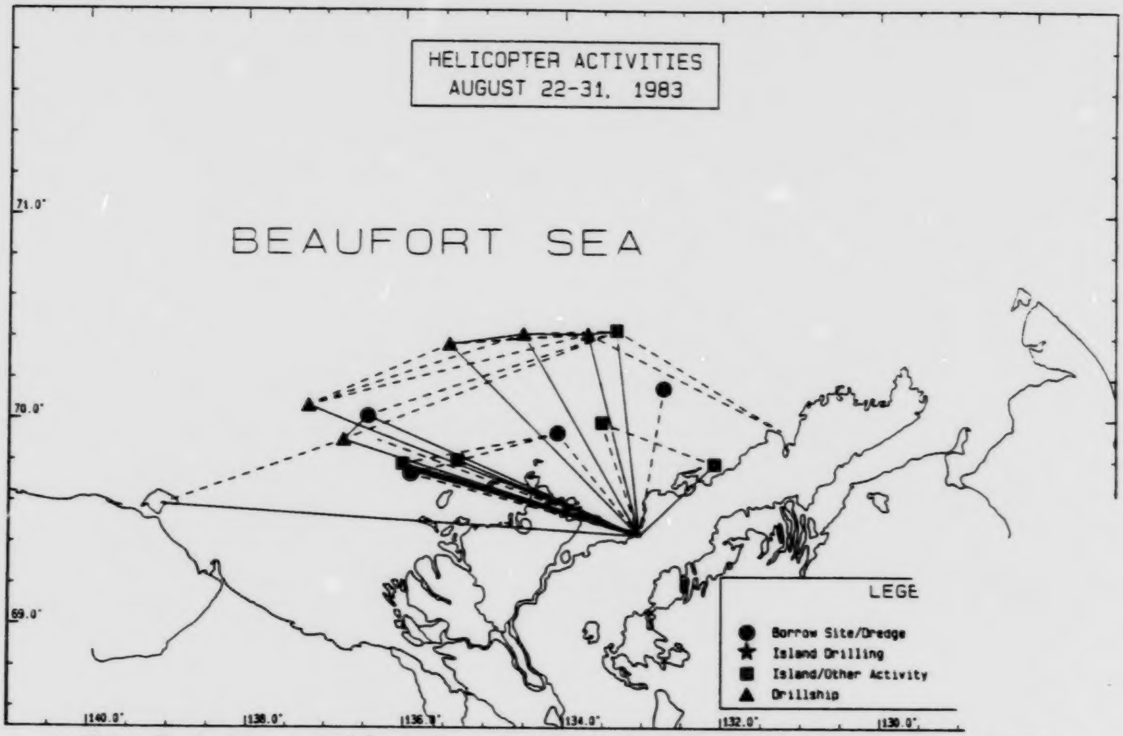
Map B.4-8: Vessel Activities September 1 to 10, 1983.


HELICOPTER ACTIVITIES
AUGUST 1-10, 1983
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
LEGEND
TRIP FREQ
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship

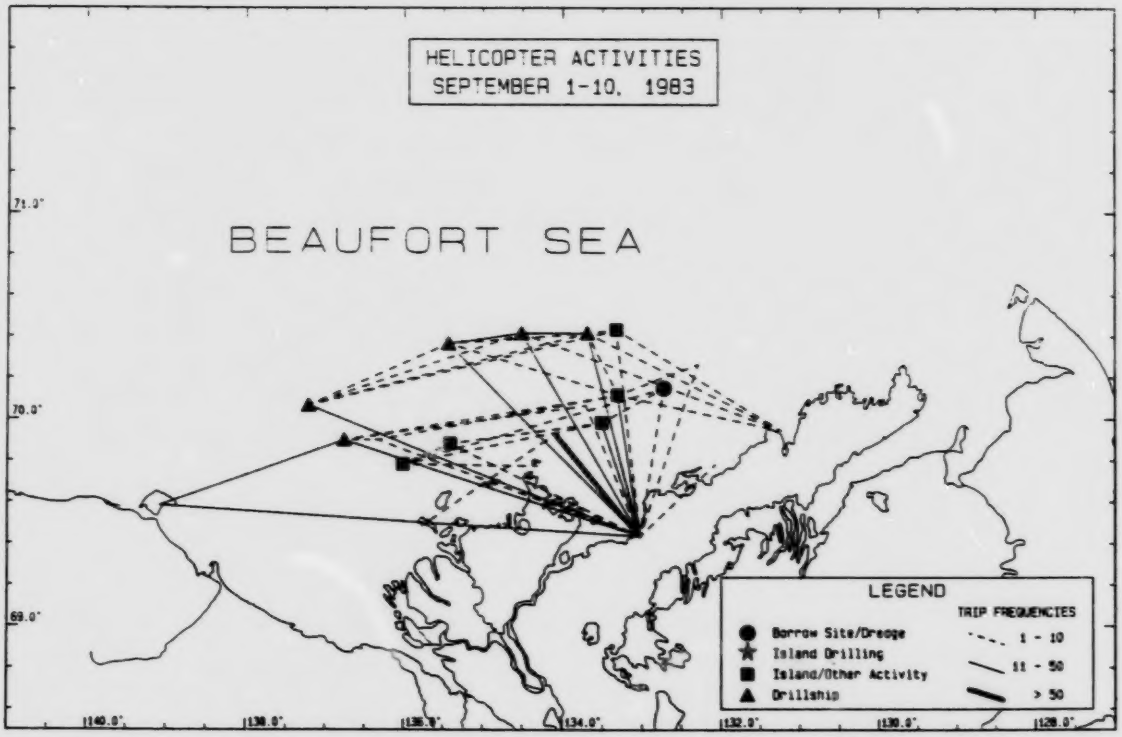
Map B.4-9: Helicopter Activities August 1 to 10, 1983.


HELICOPTER ACTIVITIES
AUGUST 11-21, 1983
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

Map B.4-10: Helicopter Activities August 11 to 21, 1983.


HELICOPTER ACTIVITIES
AUGUST 22-31, 1983
71.0°
70.0°
69.0°
BEAUFORT SEA
LEGE
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°

Map B.4-11: Helicopter Activities August 22 to 31, 1983.

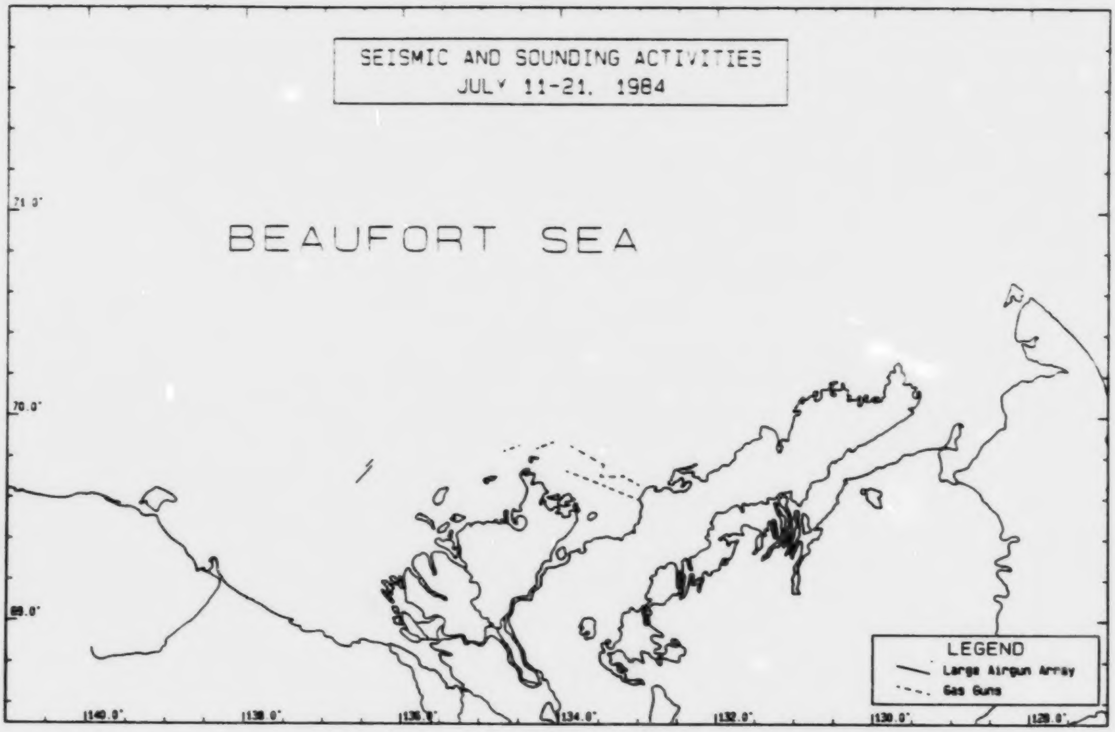

HELICOPTER ACTIVITIES
SEPTEMBER 1-10, 1983
71.0°
70.0°
69.0°
BEAUFORT SEA
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

Map B.4-12: Helicopter Activities September 1 to 10, 1983.

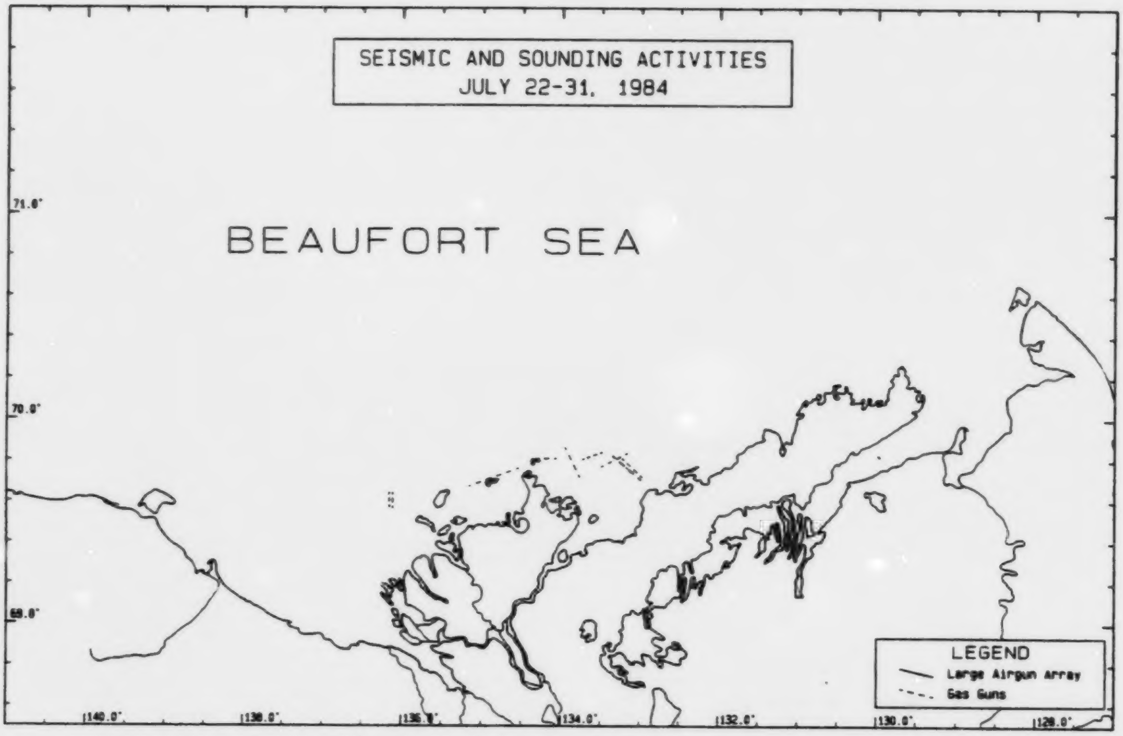
B.5 1984 INDUSTRIAL ACTIVITIES

The following section presents maps of:

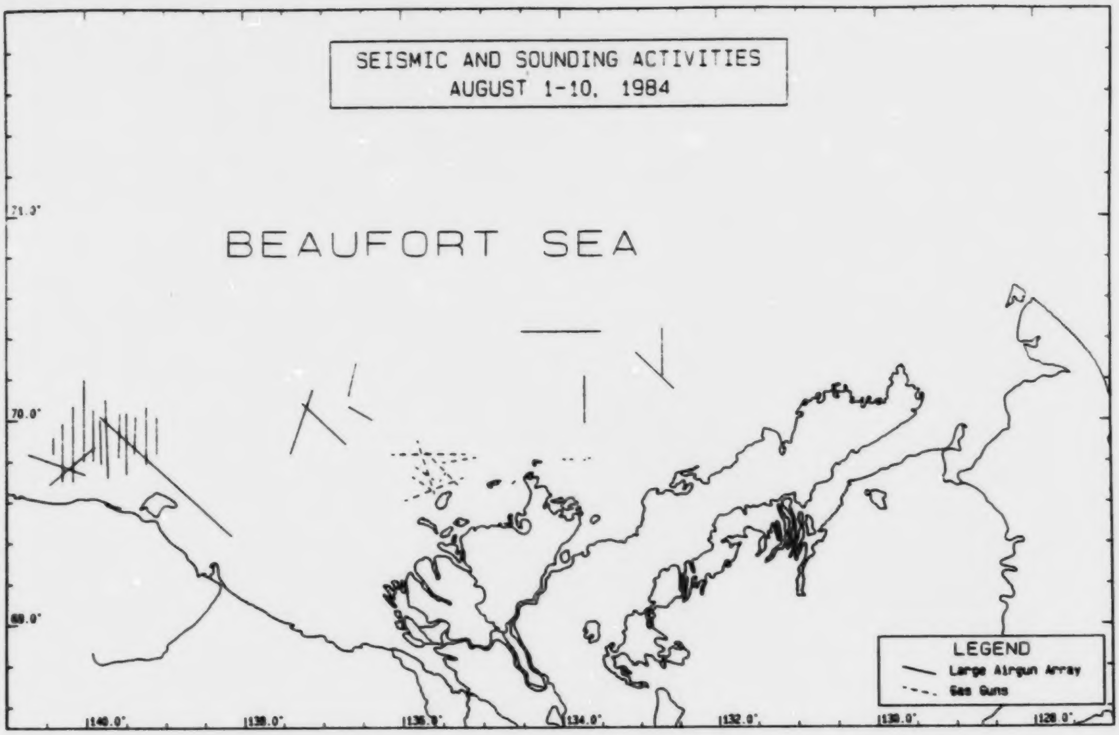
1) 1984 Seismic and Sounding Activities from July 11 to September 30,
2) 1984 Vessel Activities from August 1 to September 10, and
3) 1984 Helicopter Activities from August 1 to September 10.


SEISMIC AND SOUNDING ACTIVITIES
JULY 11-21, 1984
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Gas Guns

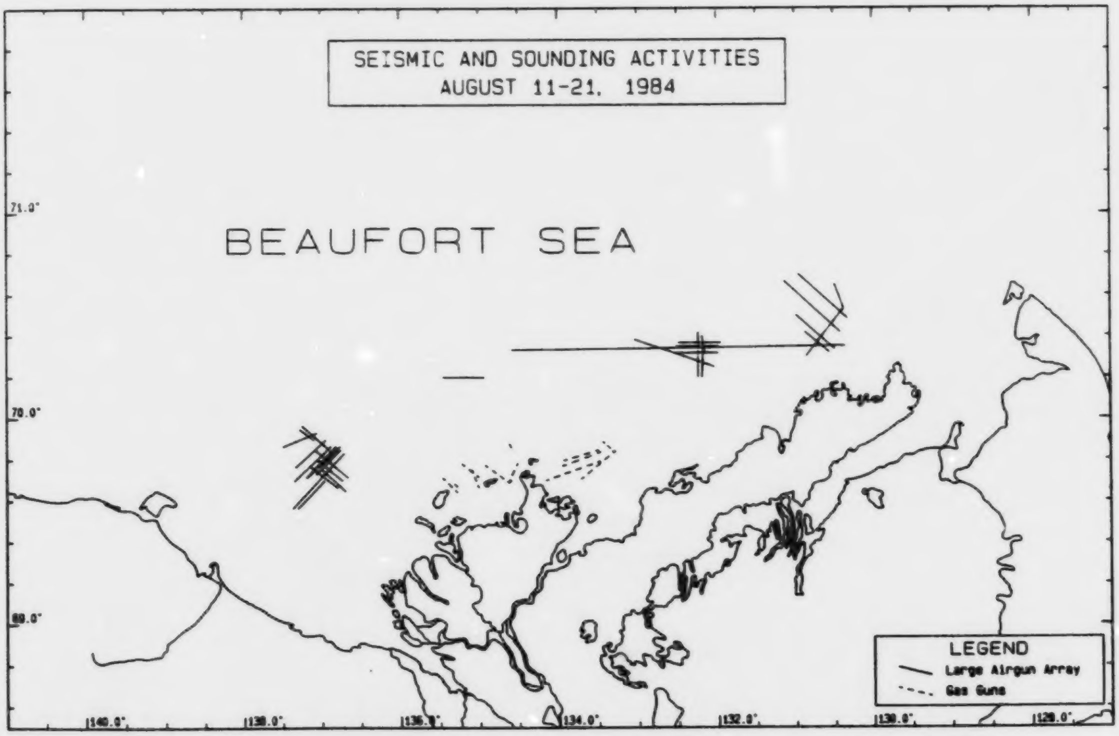
Map B.5-1: Seismic Activities July 11 to 21, 1984.


SEISMIC AND SOUNDING ACTIVITIES
JULY 22-31, 1984
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Gas Guns

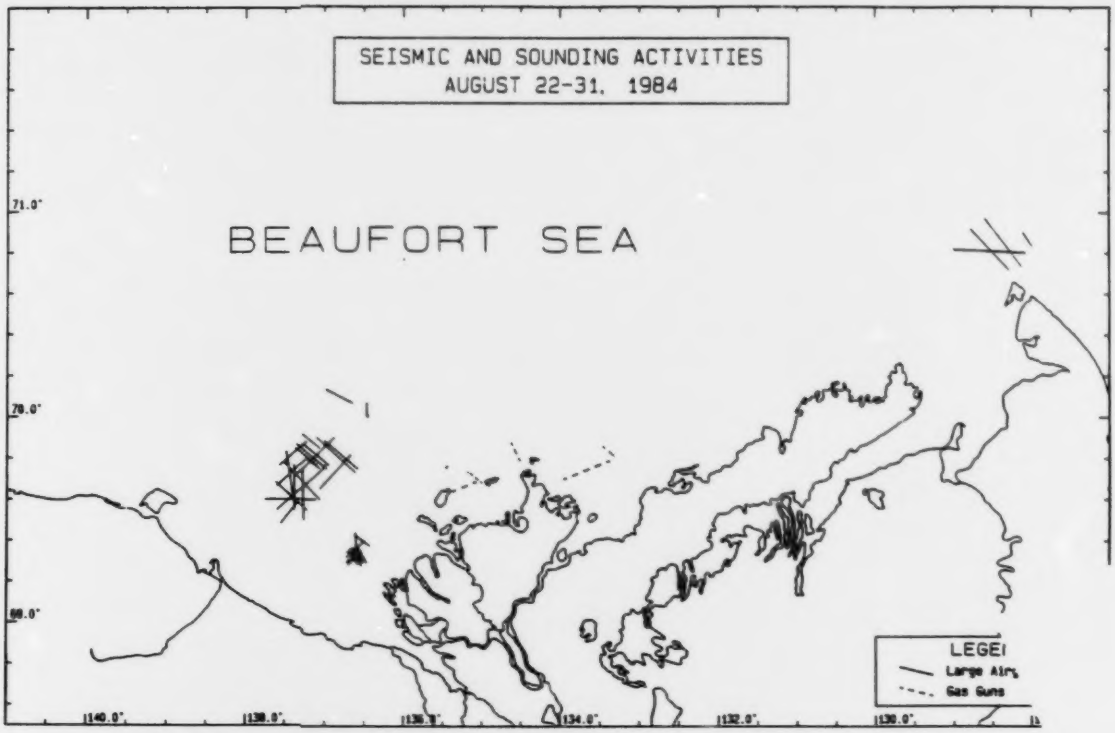
Map B.5-2: Seismic Activities July 22 to 31, 1984.


SEISMIC AND SOUNDING ACTIVITIES
AUGUST 1-10, 1984
BEAUFORT SEA
71.0°
70.0°
69.0°
LEGEND
Large Airgun Array
Gas Guns
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

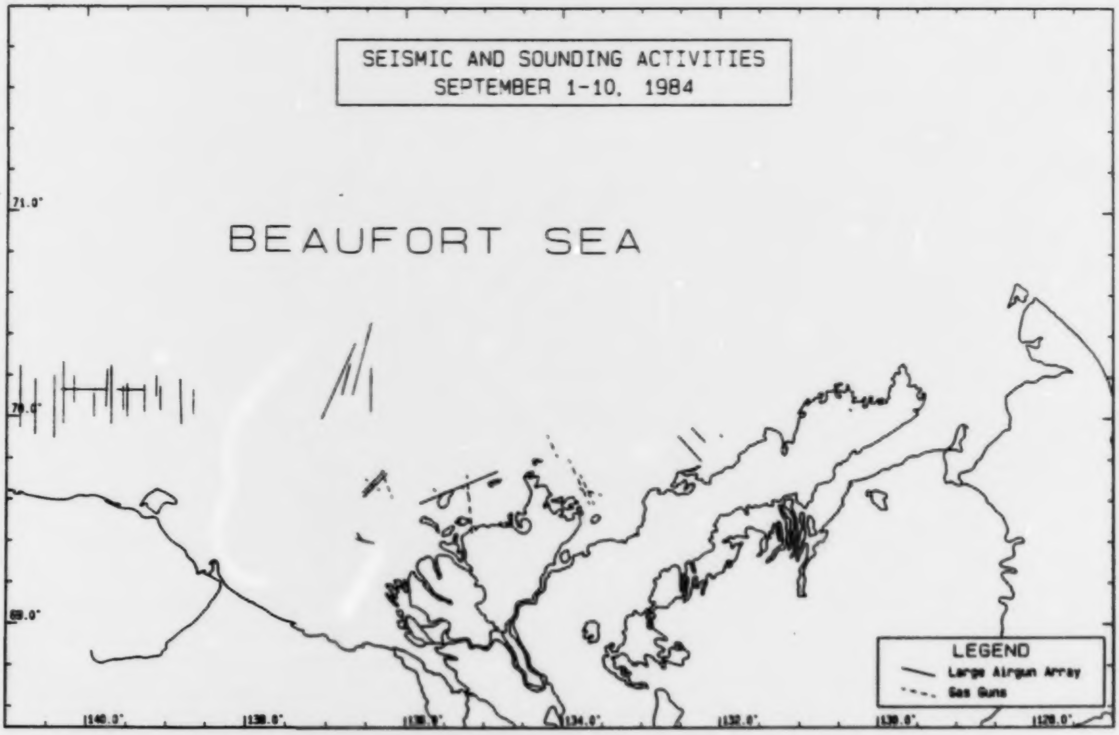
Map B.5-3: Seismic Activities August 1 to 10, 1984.


SEISMIC AND SOUNDING ACTIVITIES
AUGUST 11-21, 1984
BEAUFORT SEA
71.0°
70.0°
69.0°
LEGEND
Large Airgun Array
Gas Guns
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

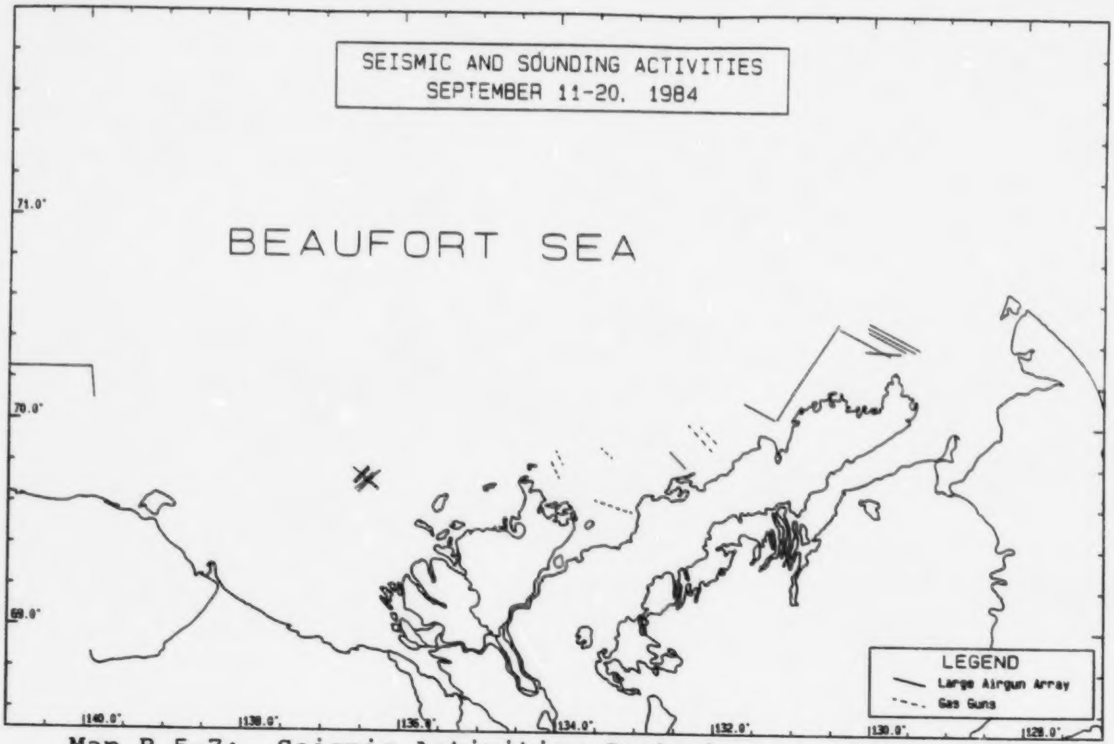
Map B.5-4: Seismic Activities August 11 to 21, 1984.


SEISMIC AND SOUNDING ACTIVITIES
AUGUST 22-31, 1984
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
LEGE
Large Air
Gas Guns

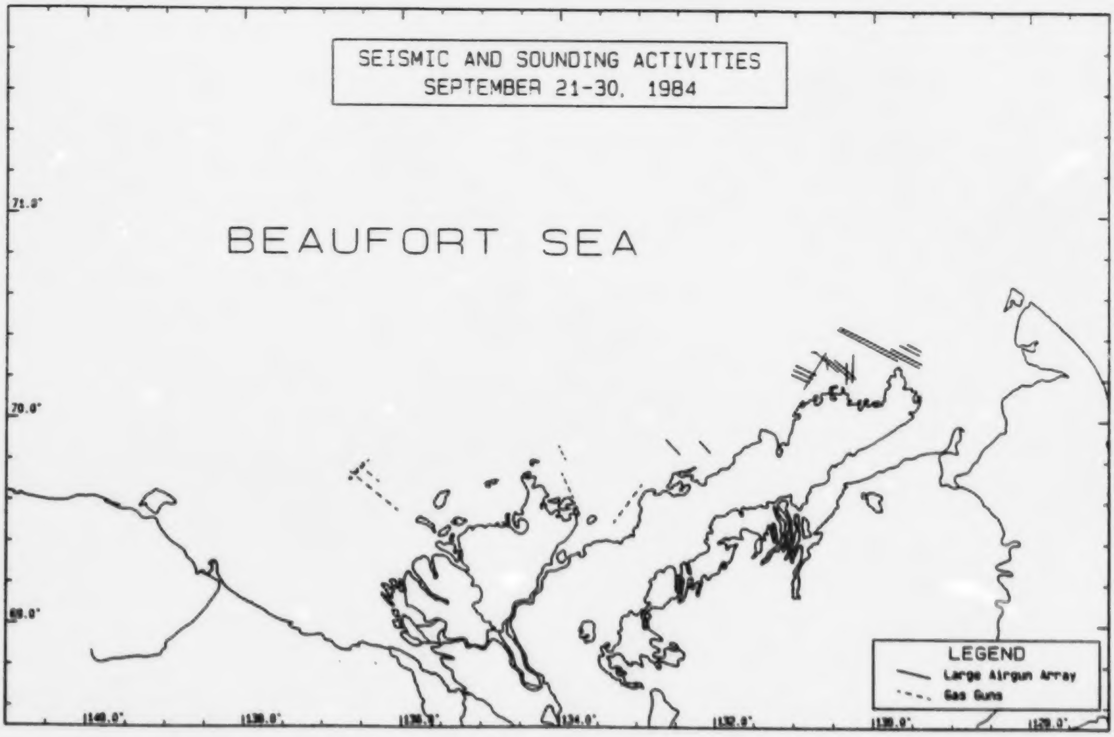
Map B.5-5: Seismic Activities August 22 to 31, 1984.


SEISMIC AND SOUNDING ACTIVITIES
SEPTEMBER 1-10, 1984
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Gas Guns

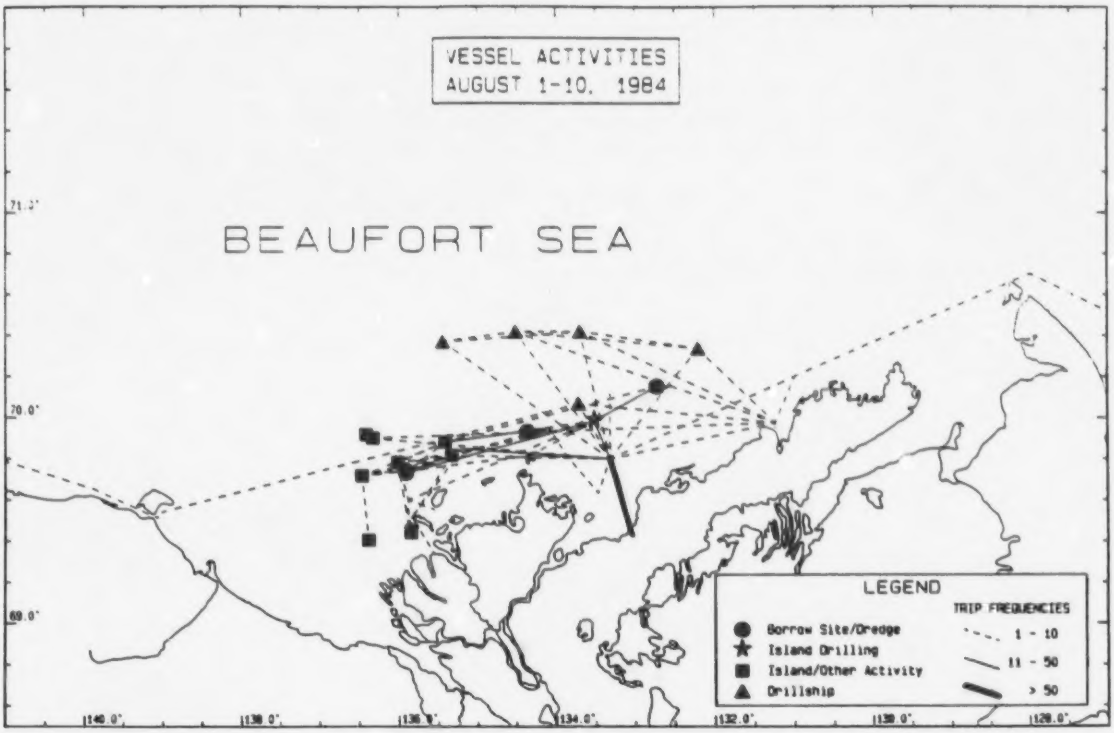
Map B.5-6: Seismic Activities September 1 to 10, 1984.


SEISMIC AND SOUNDING ACTIVITIES
SEPTEMBER 11-20, 1984
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Gas Guns

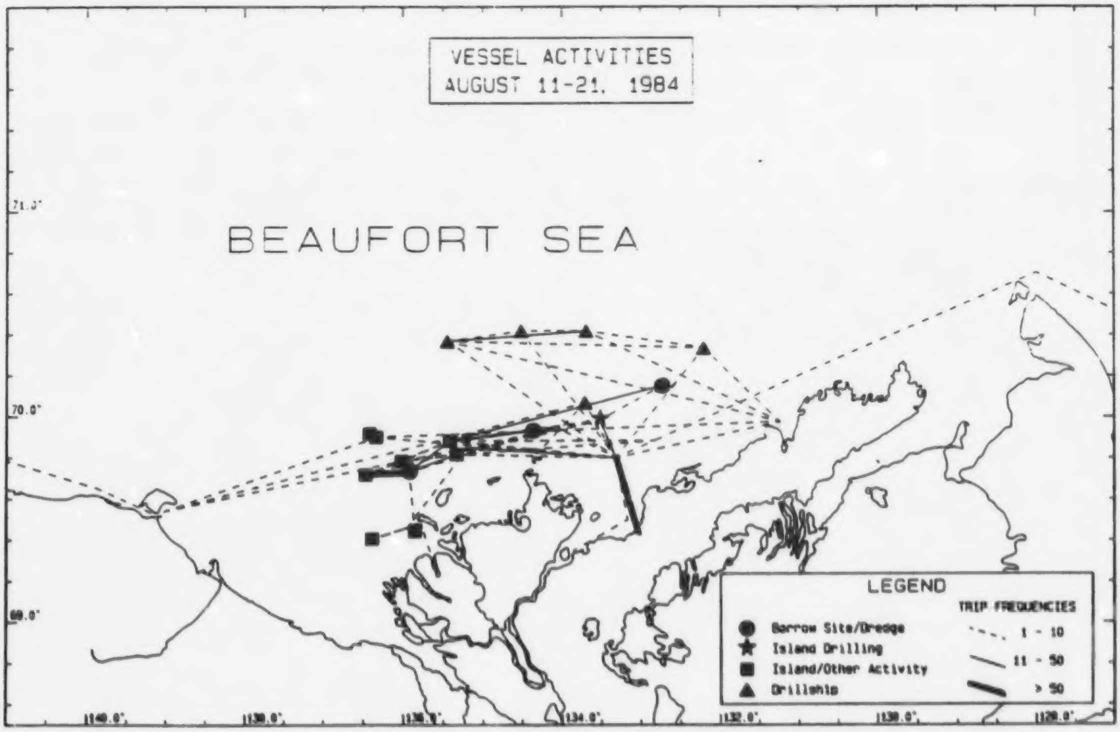
Map B.5-7: Seismic Activities September 11 to 20, 1984


SEISMIC AND SOUNDING ACTIVITIES
SEPTEMBER 21-30, 1984
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Gas Guns

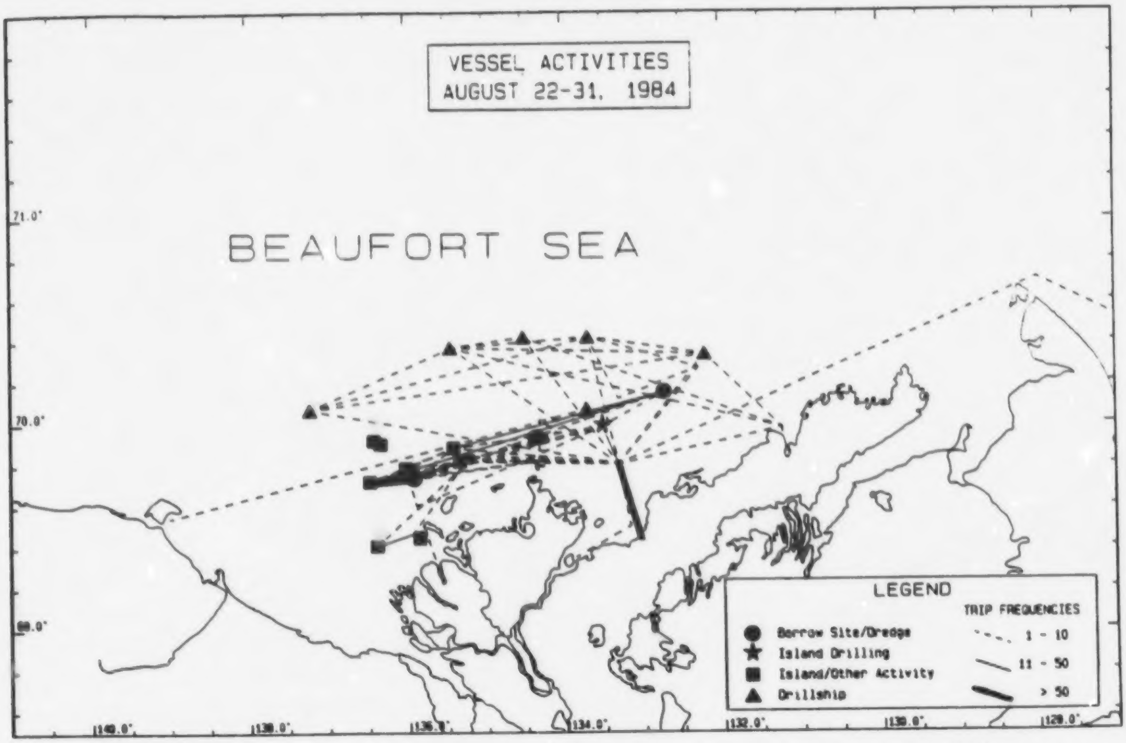
Map B.5-8: Seismic Activities September 21 to 30, 1984.


VESSEL ACTIVITIES
AUGUST 1-10, 1984
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

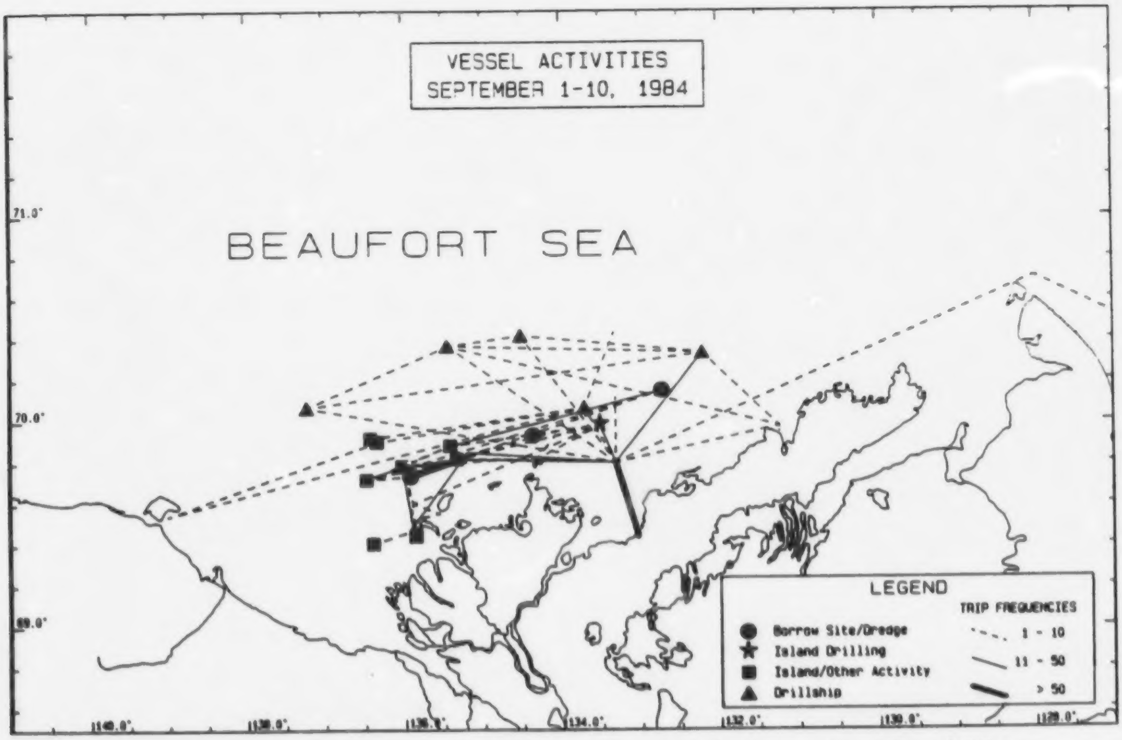
Map B.5-9: Vessel Activities August 1 to 10, 1984.


VESSEL ACTIVITIES
AUGUST 11-21, 1984
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

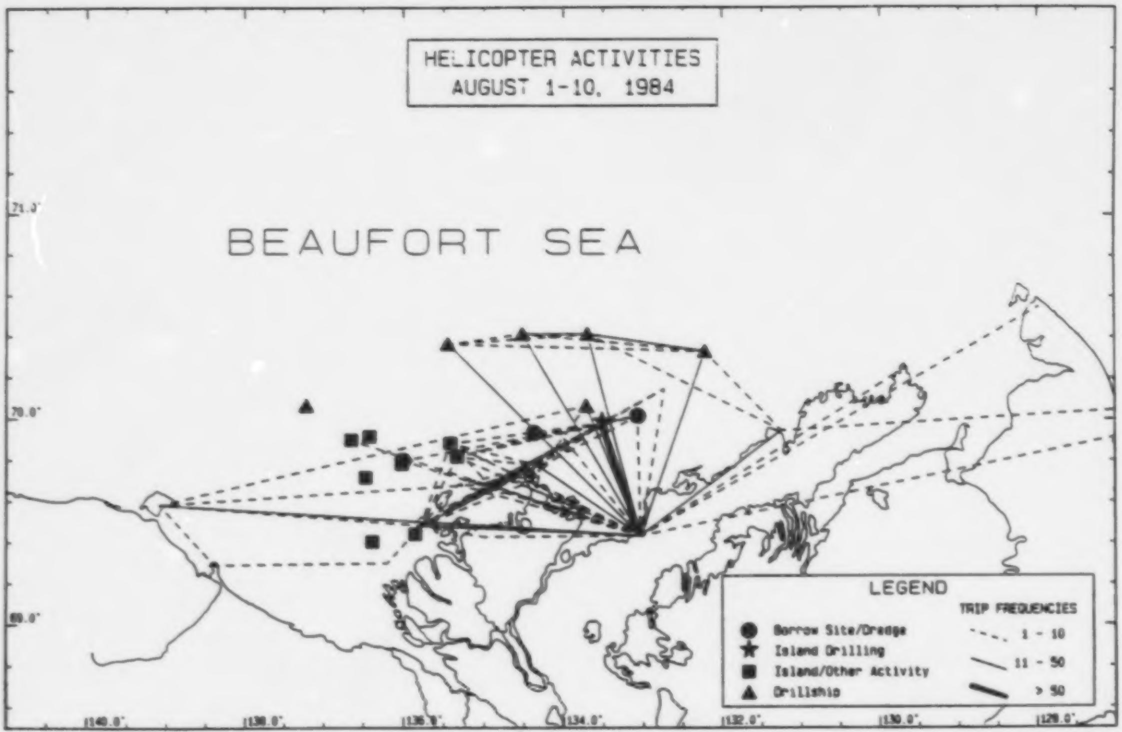
Map B.5-10: Vessel Activities August 11 to 21, 1984.


VESSEL ACTIVITIES
AUGUST 22-31, 1984
BEAUFORT SEA
71.0°
70.0°
69.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

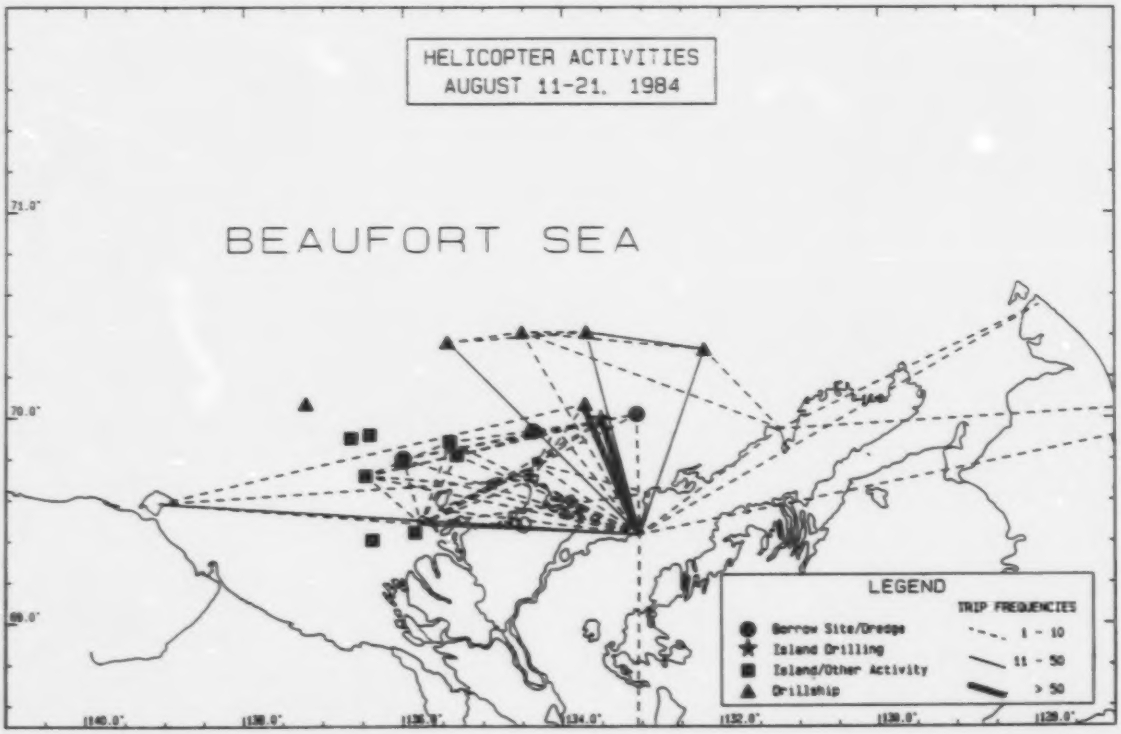
Map B.5-11: Vessel Activities August 22 to 31, 1984.


VESSEL ACTIVITIES
SEPTEMBER 1-10, 1984
BEAUFORT SEA
71.0°
70.0°
69.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

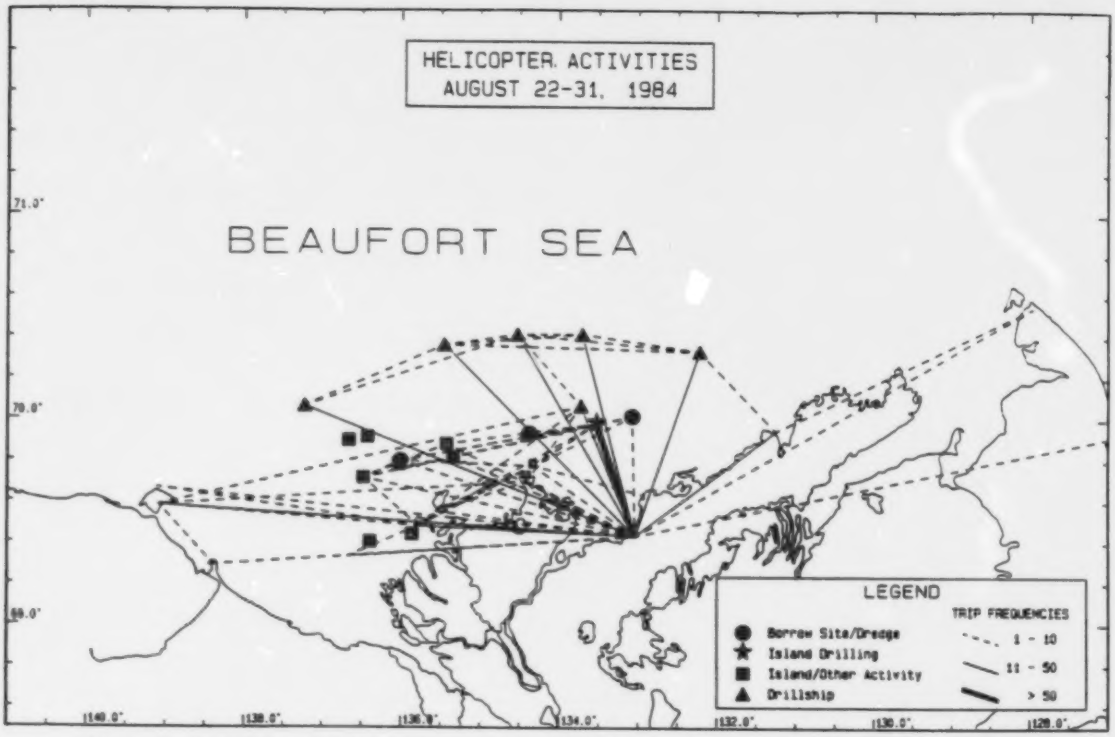
Map B.5-12: Vessel Activities September 1 to 10, 1984.


HELICOPTER ACTIVITIES
AUGUST 1-10, 1984
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

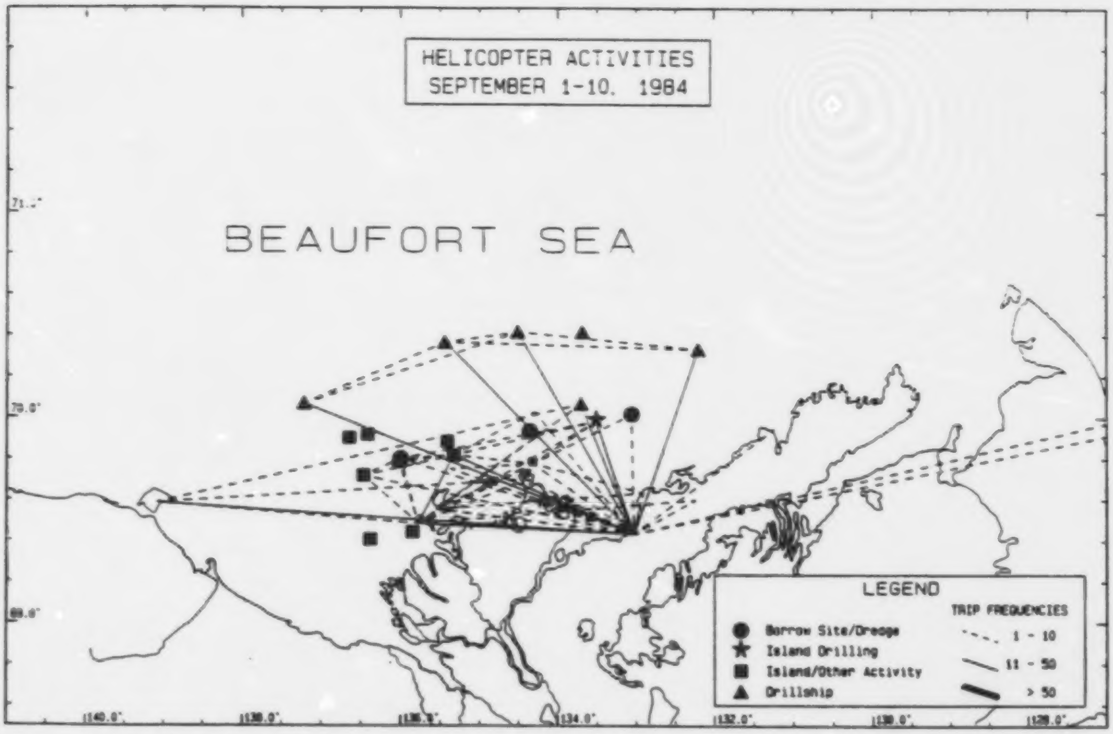
Map B.5-13: Helicopter Activities August 1 to 10, 1984.


HELICOPTER ACTIVITIES
AUGUST 11-21, 1984
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

Map B.5-14: Helicopter Activities August 11 to 21, 1984.


HELICOPTER ACTIVITIES
AUGUST 22-31, 1984
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
TRIP FREQUENCIES
1 - 10
11 - 50
> 50

Map B.5-15: Helicopter Activities August 22 to 31, 1984.

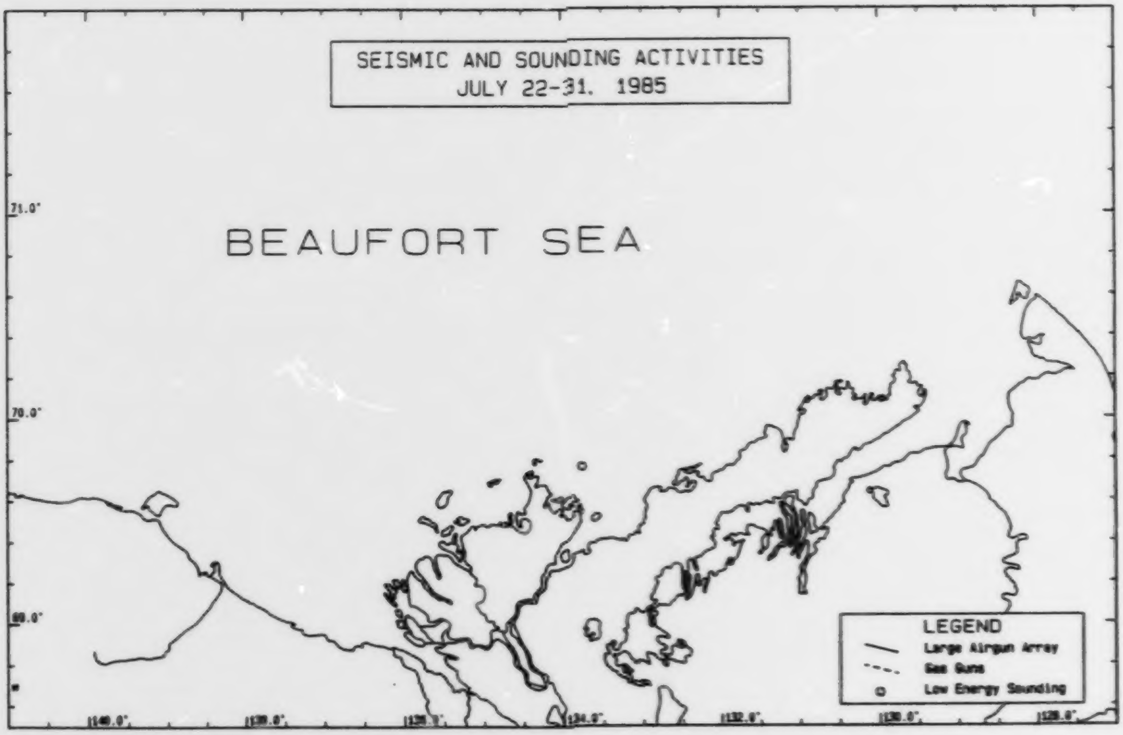

HELICOPTER ACTIVITIES
SEPTEMBER 1-10, 1984
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
TRIP FREQUENCIES
1 - 10
11 - 50
> 50

Map B.5-16: Helicopter Activities September 1 to 10, 1984.

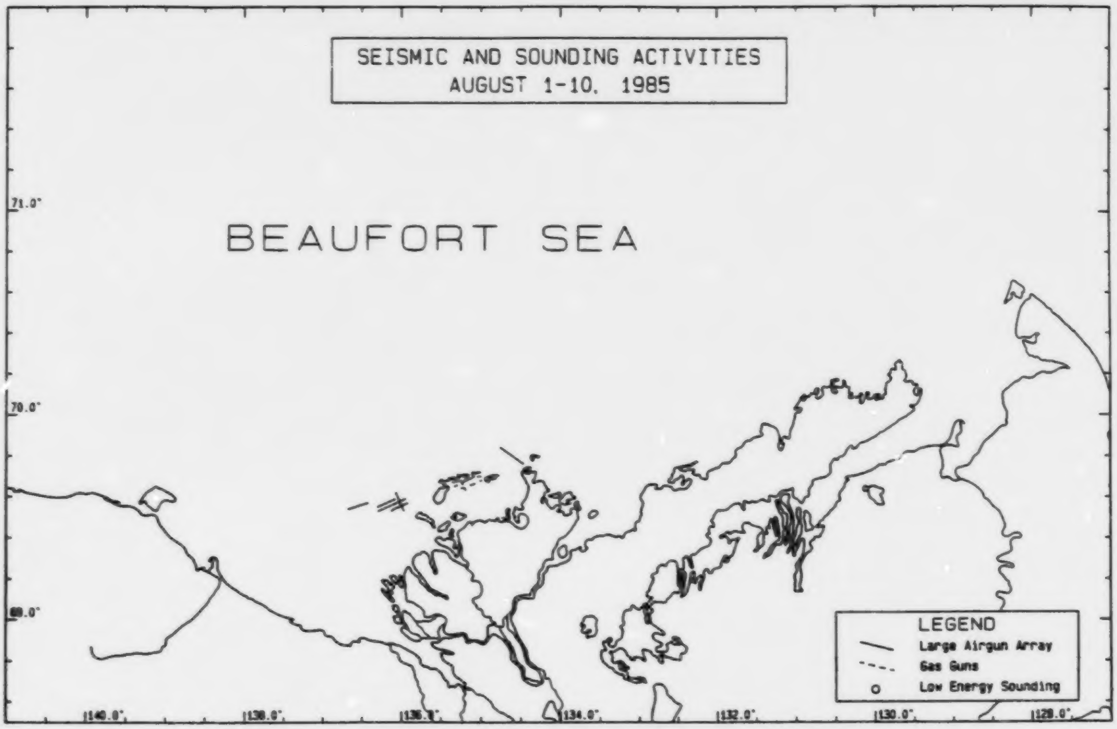
B.6 1985 INDUSTRIAL ACTIVITIES

The following section presents maps of:

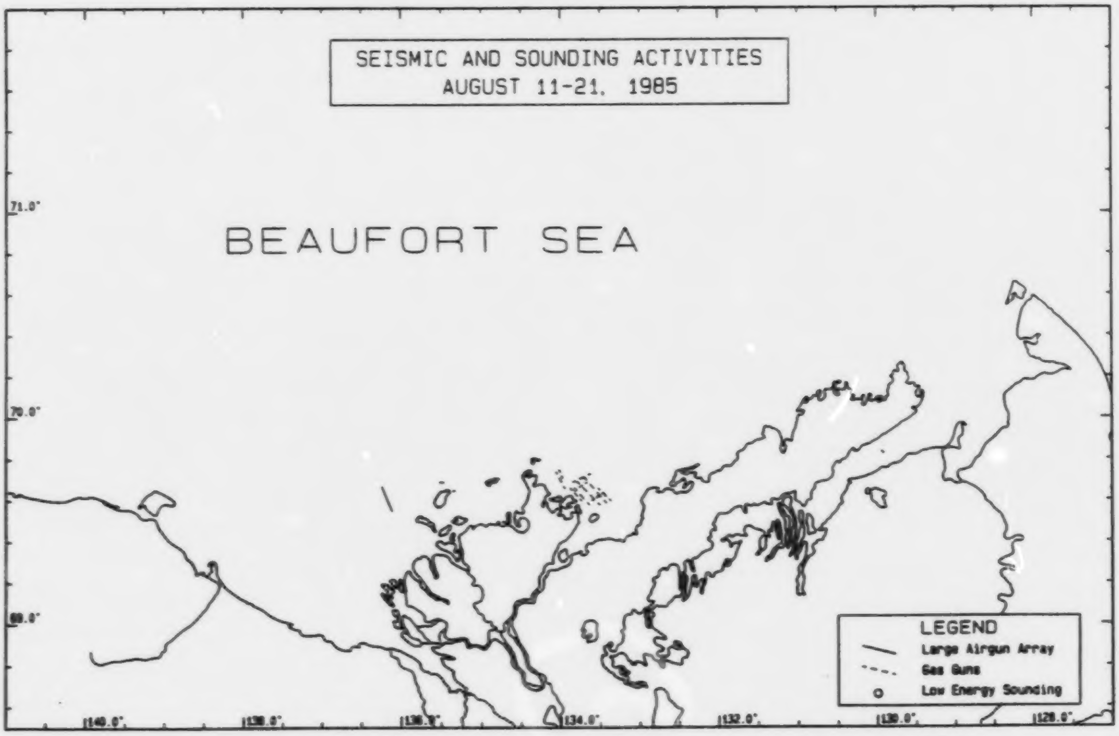
1) 1985 Seismic and Sounding Activities from July 22 to September 30,
2) 1985 Vessel Activities from July 1 to September 30, and
3) 1985 Helicopter Activities from July 1 to September 30.


SEISMIC AND SOUNDING ACTIVITIES
JULY 22-31, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Gas Guns
Low Energy Sounding

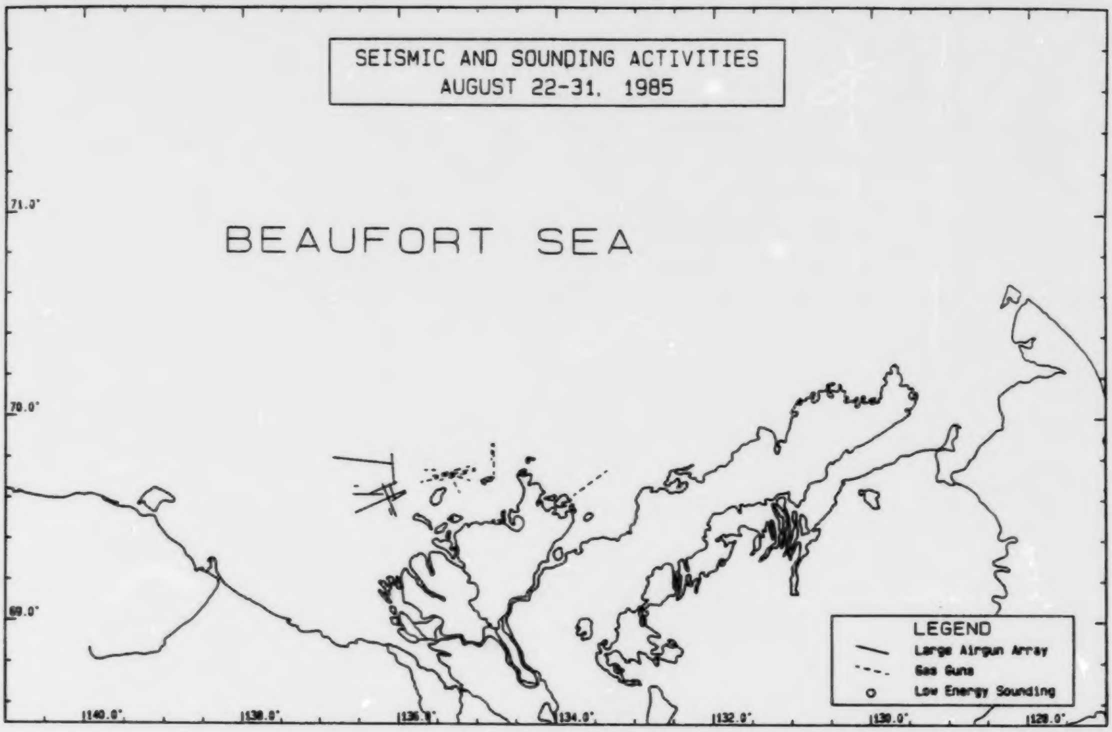
Map B.6-1: Seismic Activities July 22 to 31, 1985.


SEISMIC AND SOUNDING ACTIVITIES
AUGUST 1-10, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
LEGEND
Large Airgun Array
Gas Guns
Low Energy Sounding
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

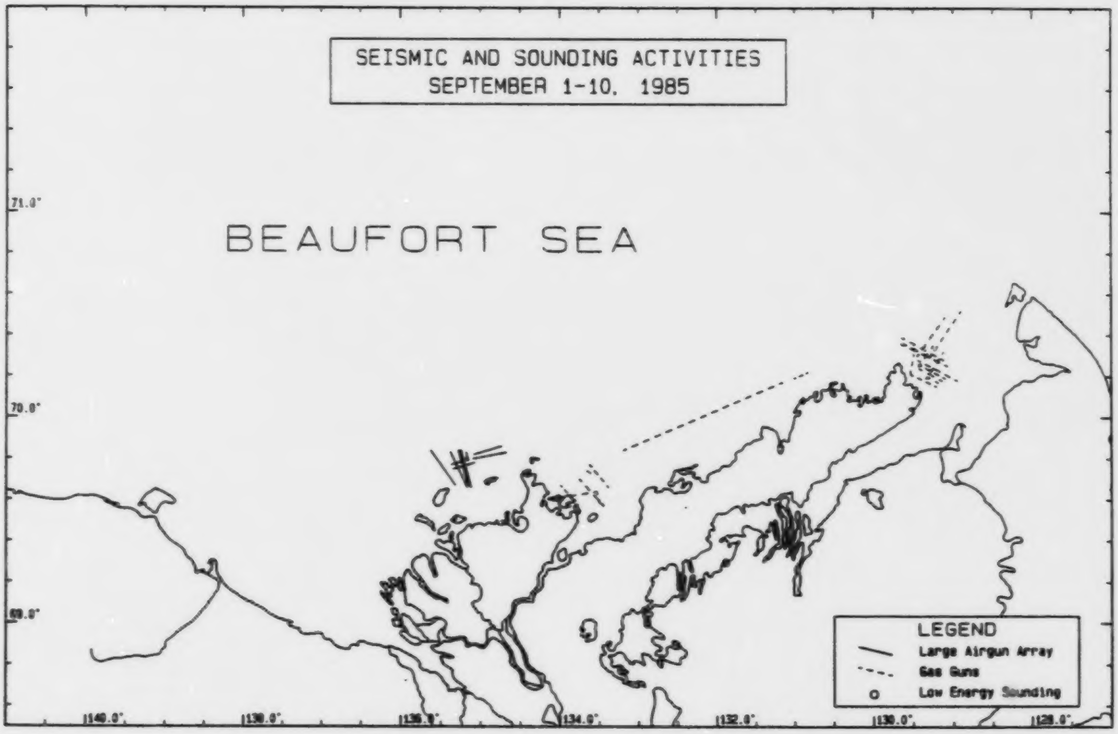
Map B.6-2: Seismic Activities August 1 to 10, 1985.


SEISMIC AND SOUNDING ACTIVITIES
AUGUST 11-21, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
LEGEND
Large Airgun Array
Gas Guns
Low Energy Sounding
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

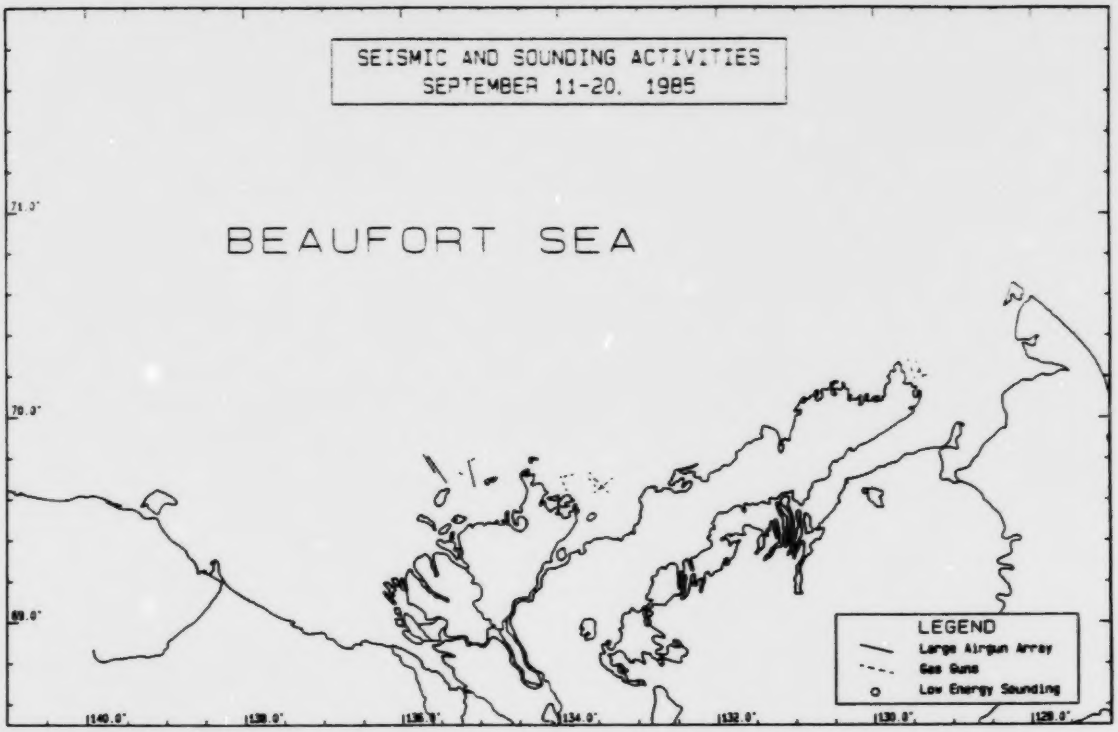
Map B.6-3: Seismic Activities August 11 to 21, 1985.


SEISMIC AND SOUNDING ACTIVITIES
AUGUST 22-31, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Gas Guns
Low Energy Sounding

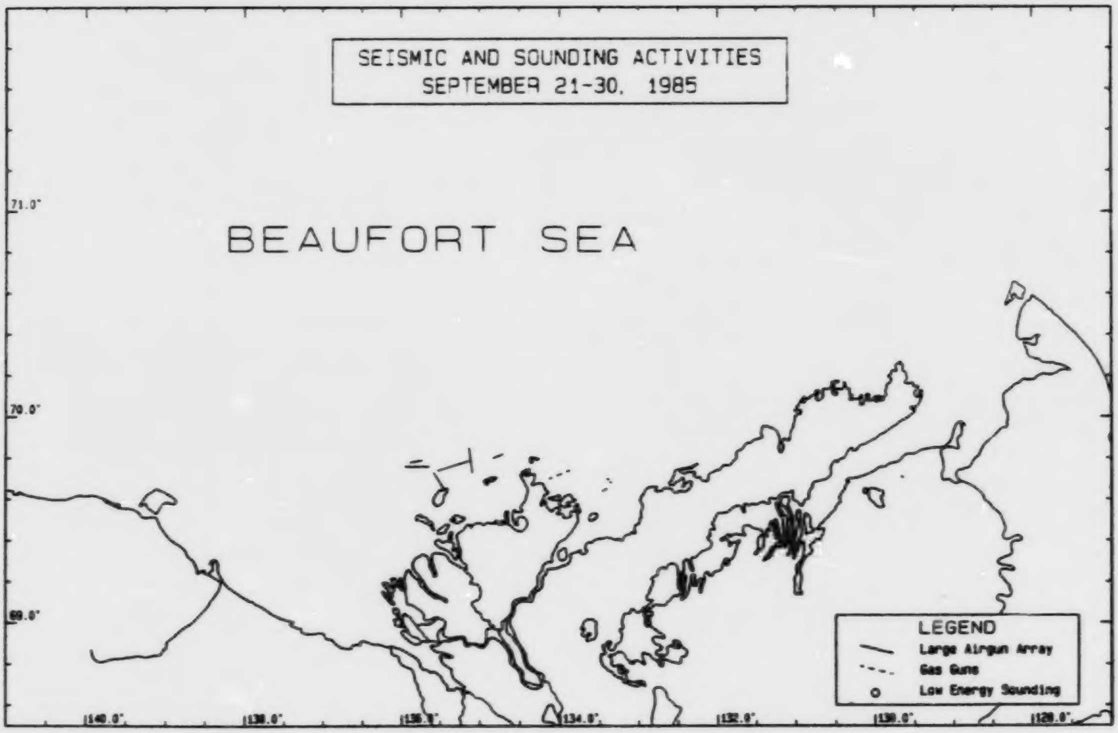
Map B.6-4: Seismic Activities August 22 to 31, 1985.


SEISMIC AND SOUNDING ACTIVITIES
SEPTEMBER 1-10, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Gas Guns
Low Energy Sounding

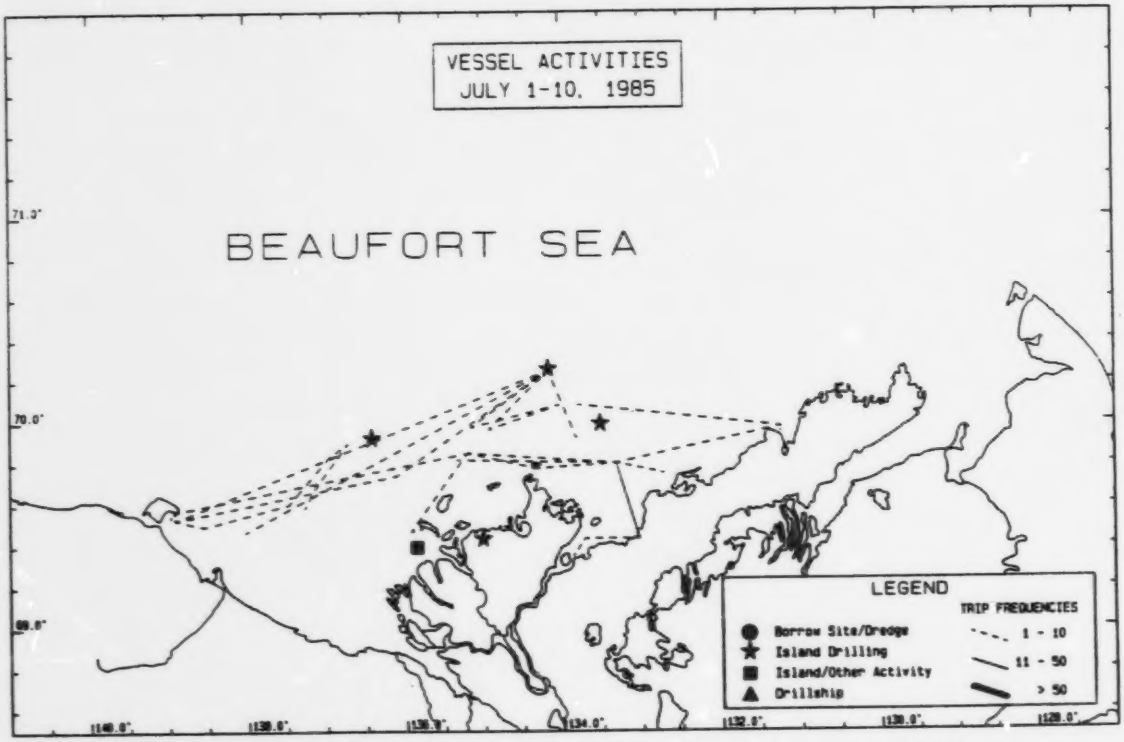
Map B.6-5: Seismic Activities September 1 to 10, 1985.


SEISMIC AND SOUNDING ACTIVITIES
SEPTEMBER 11-20, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Gas Guns
Low Energy Sounding

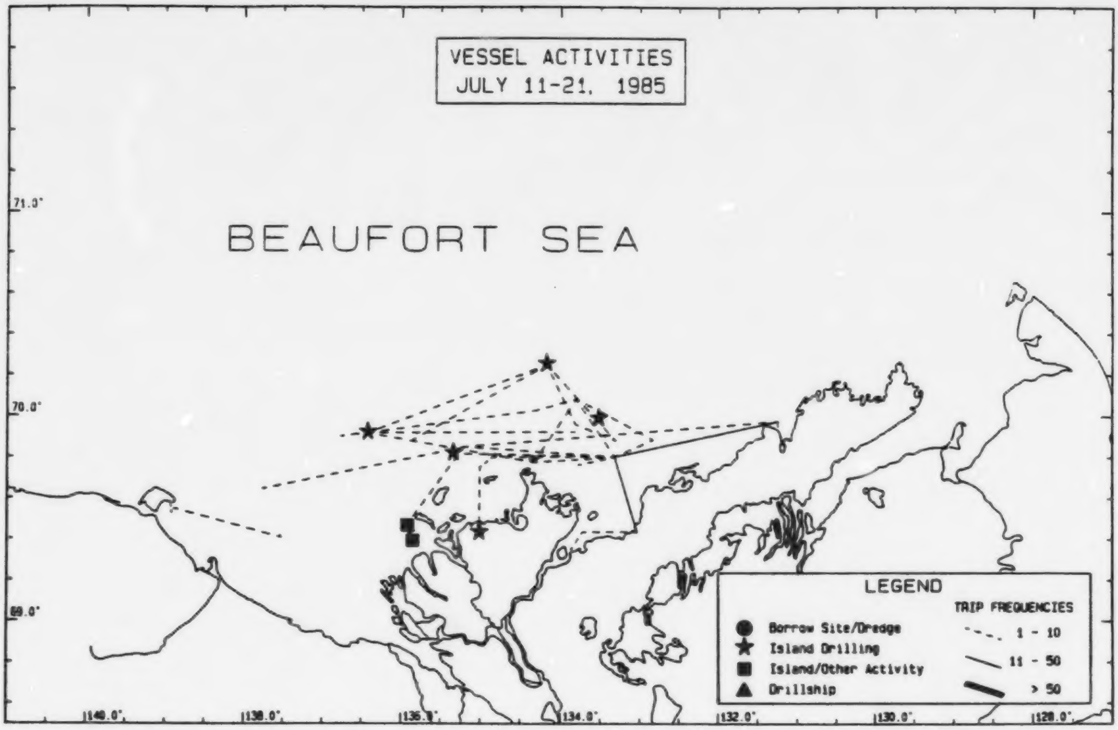
Map B.6-6: Seismic Activities September 11 to 20, 1985.


SEISMIC AND SOUNDING ACTIVITIES
SEPTEMBER 21-30, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Gas Guns
Low Energy Sounding

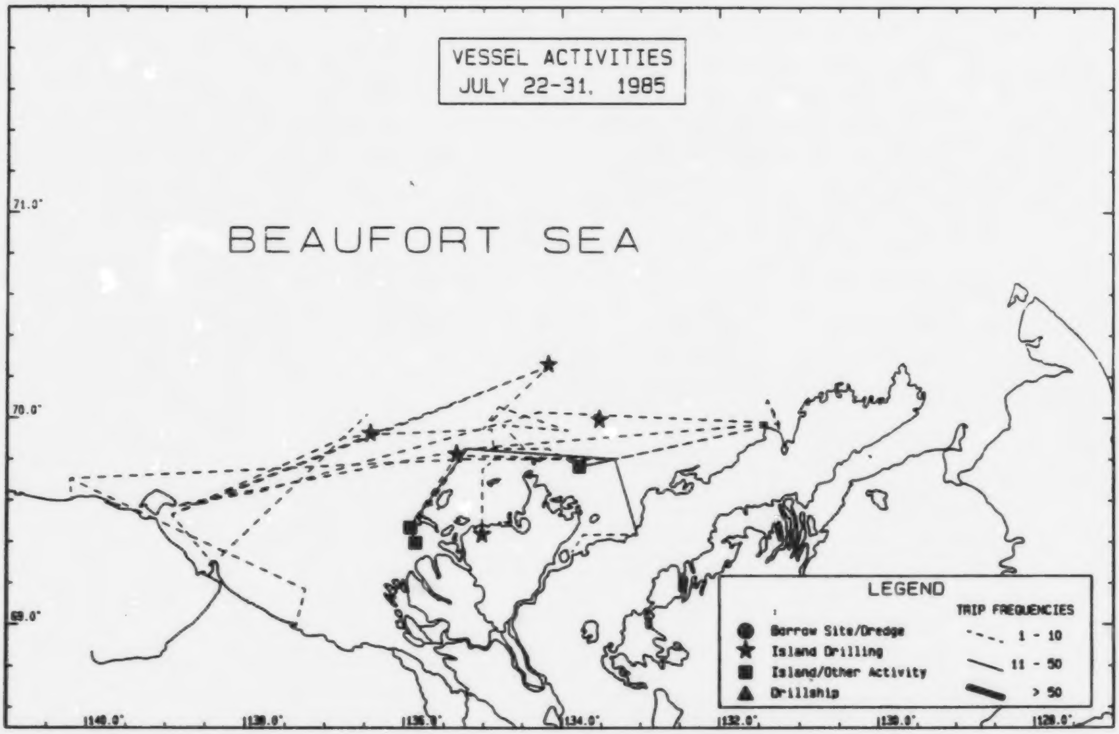
Map B.6-7: Seismic Activities September 21 to 30, 1985.


VESSEL ACTIVITIES
JULY 1-10, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

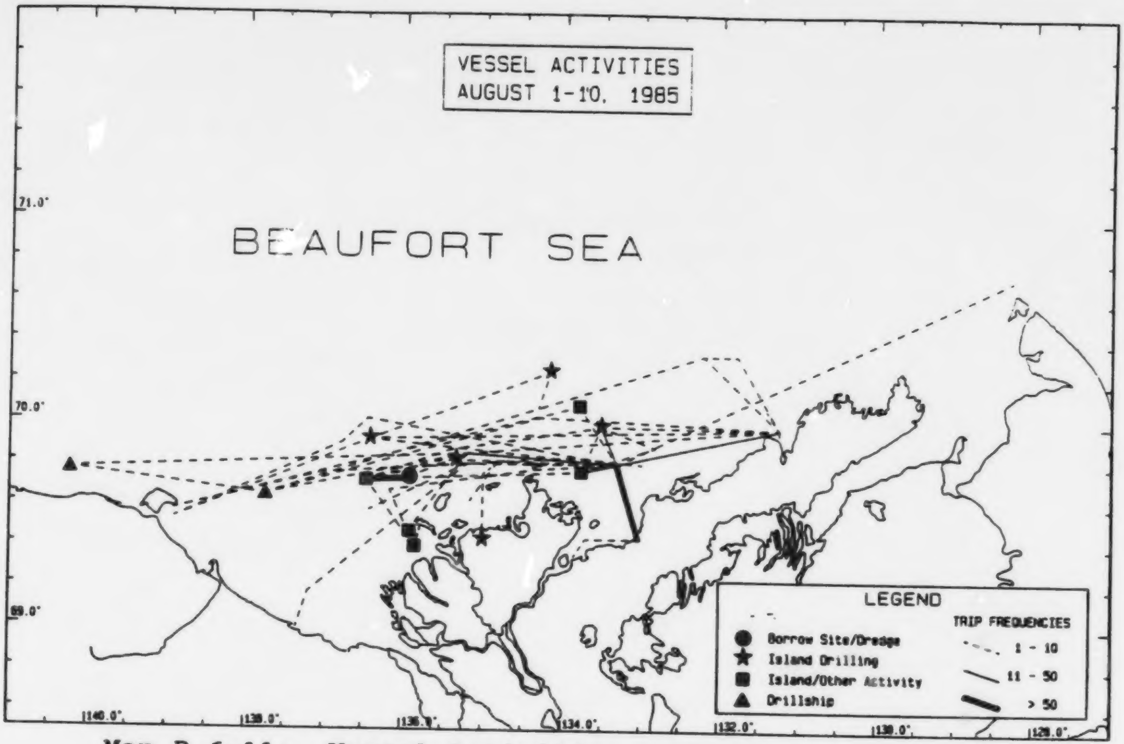
Map B.6-8: Vessel Activities July 1 to 10, 1985.


VESSEL ACTIVITIES
JULY 11-21, 1985
BEAUFORT SEA
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

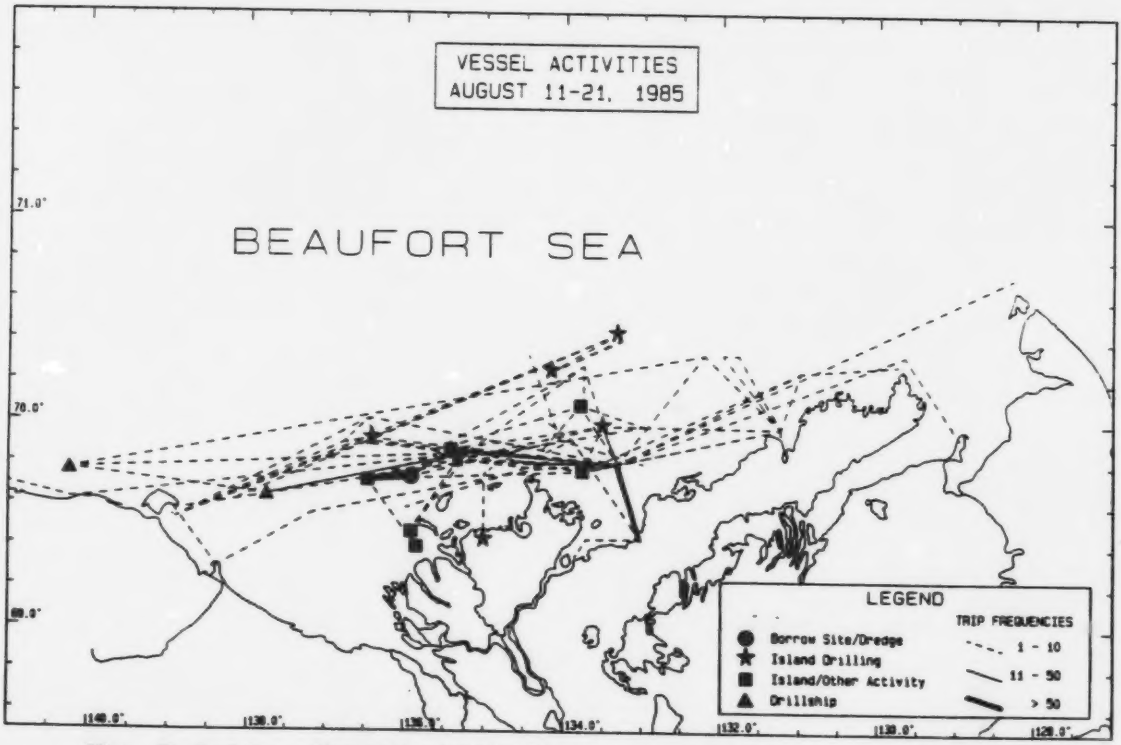
Map B.6-9: Vessel Activities July 11 to 21, 1985.


VESSEL ACTIVITIES
JULY 22-31, 1985
BEAUFORT SEA
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

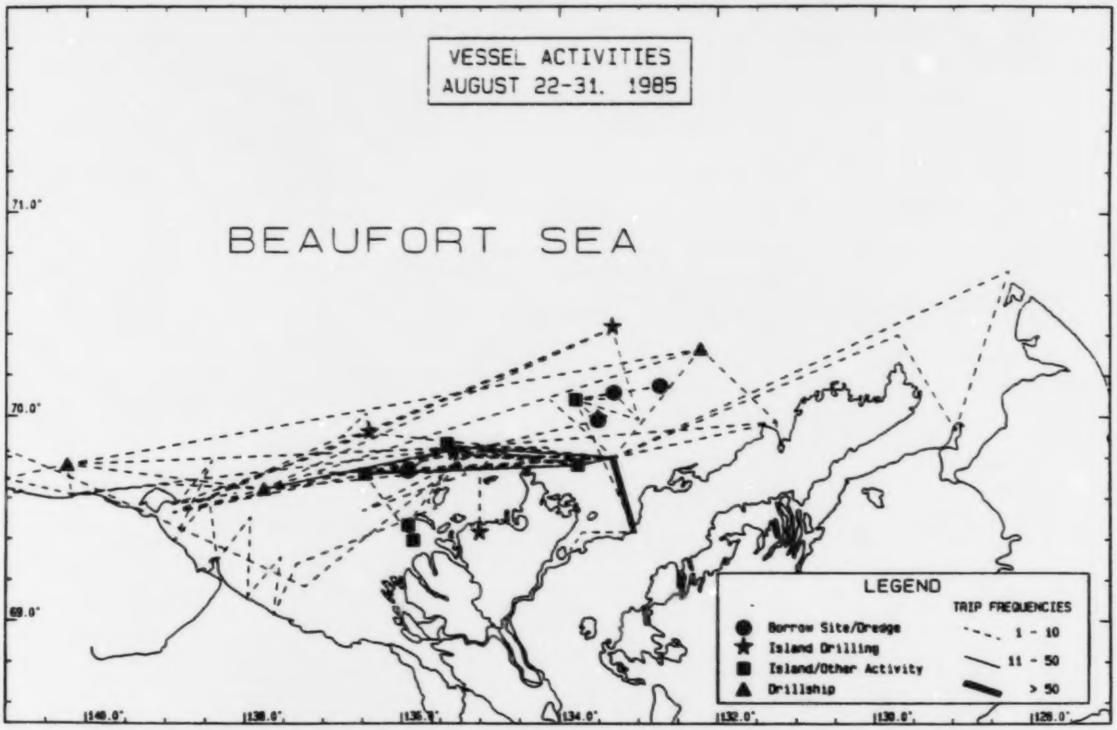
Map B.6-10: Vessel Activities July 22 to 31, 1985.


VESSEL ACTIVITIES
AUGUST 1-10, 1985
71.0°
70.0°
69.0°
BEAUFORT SEA
LEGEND
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
TRIP FREQUENCIES
1 - 10
11 - 50
> 50
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

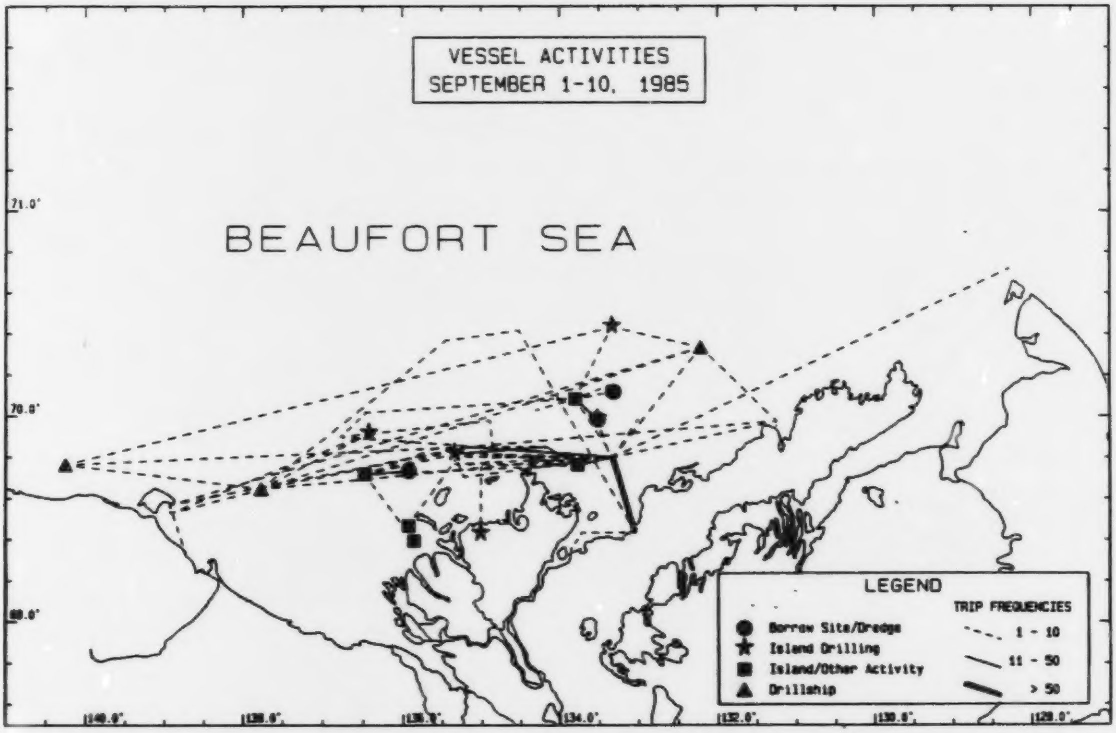
Map B.6-11: Vessel Activities August 1 to 10, 1985.


VESSEL ACTIVITIES
AUGUST 11-21, 1985
71.0°
70.0°
69.0°
BEAUFORT SEA
LEGEND
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
TRIP FREQUENCIES
1 - 10
11 - 50
> 50
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

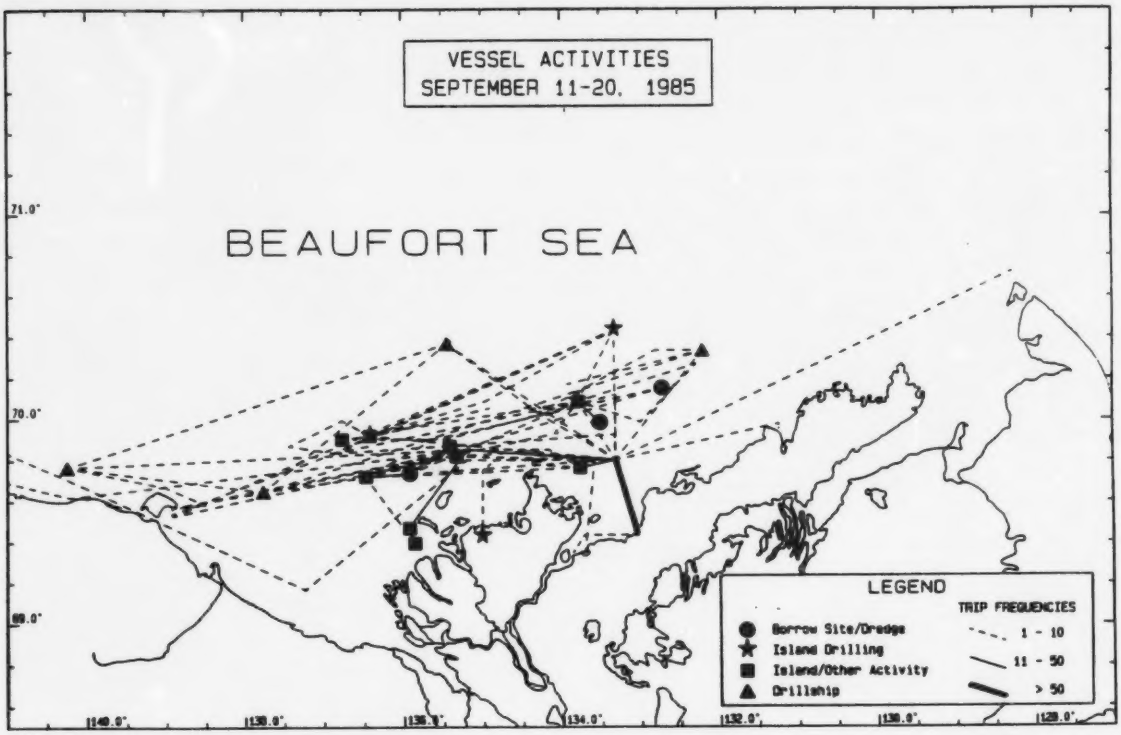
Map B.6-12: Vessel Activities August 11 to 21, 1985.


VESSEL ACTIVITIES
AUGUST 22-31, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

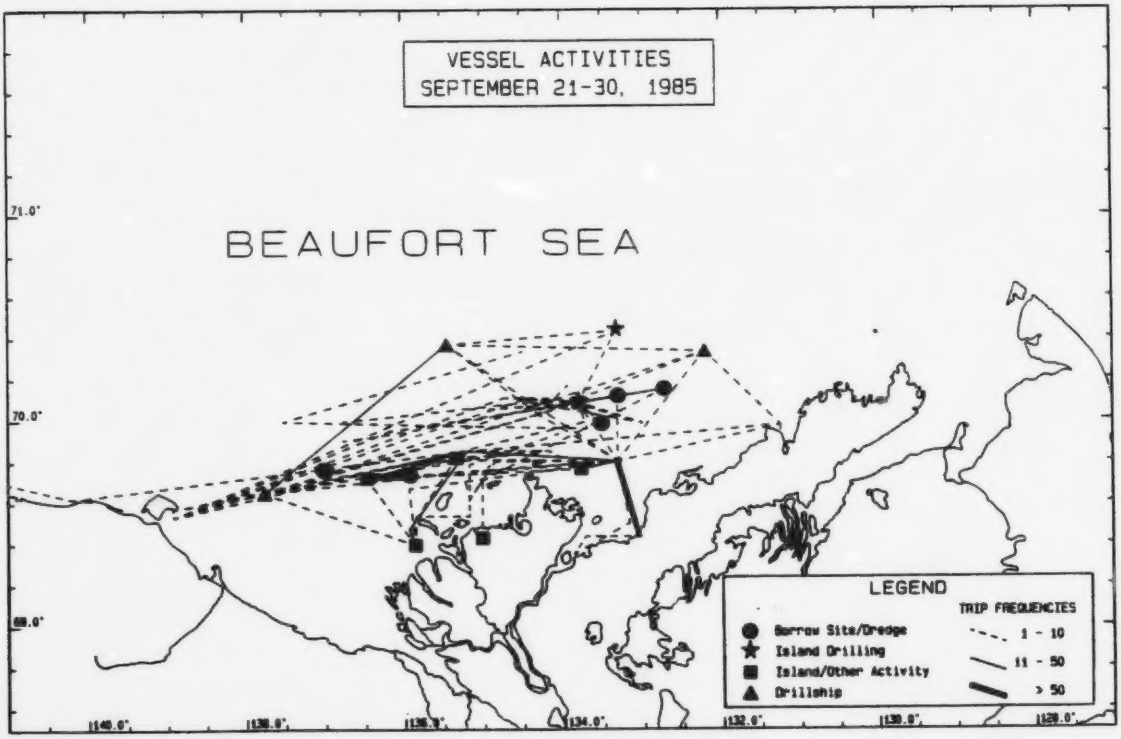
Map B.6-13: Vessel Activities August 22 to 31, 1985.


VESSEL ACTIVITIES
SEPTEMBER 1-10, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

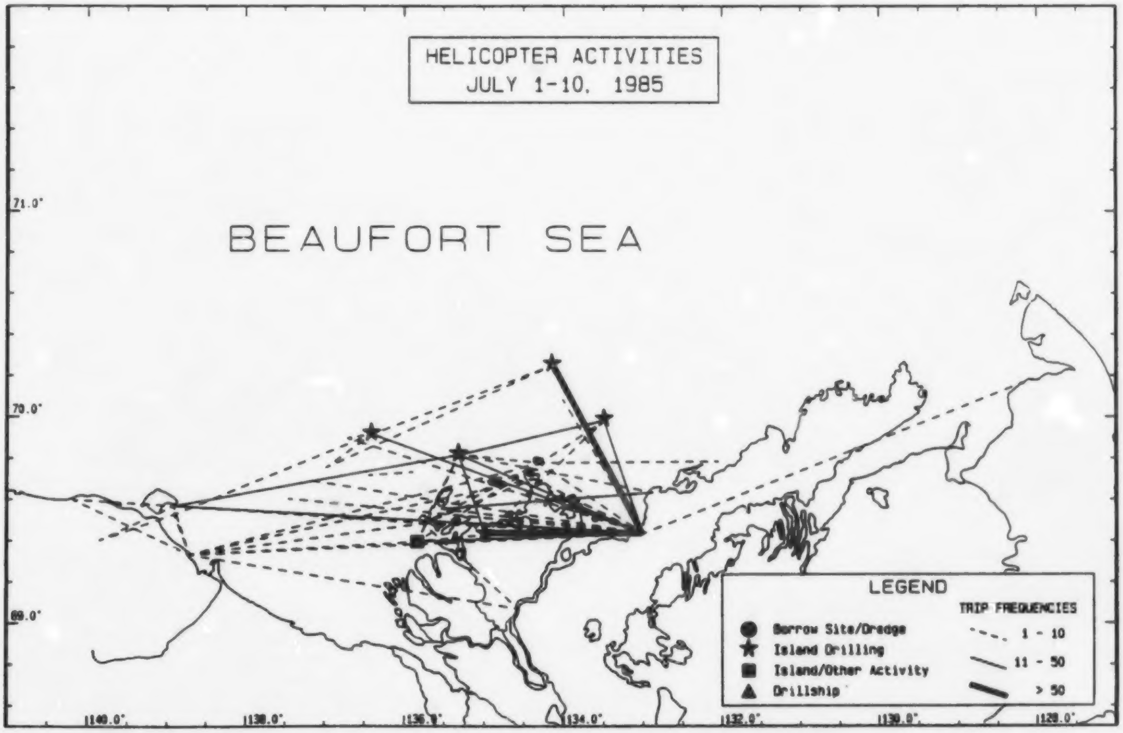
Map B.6-14: Vessel Activities September 1 to 10, 1985.


VESSEL ACTIVITIES
SEPTEMBER 11-20, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

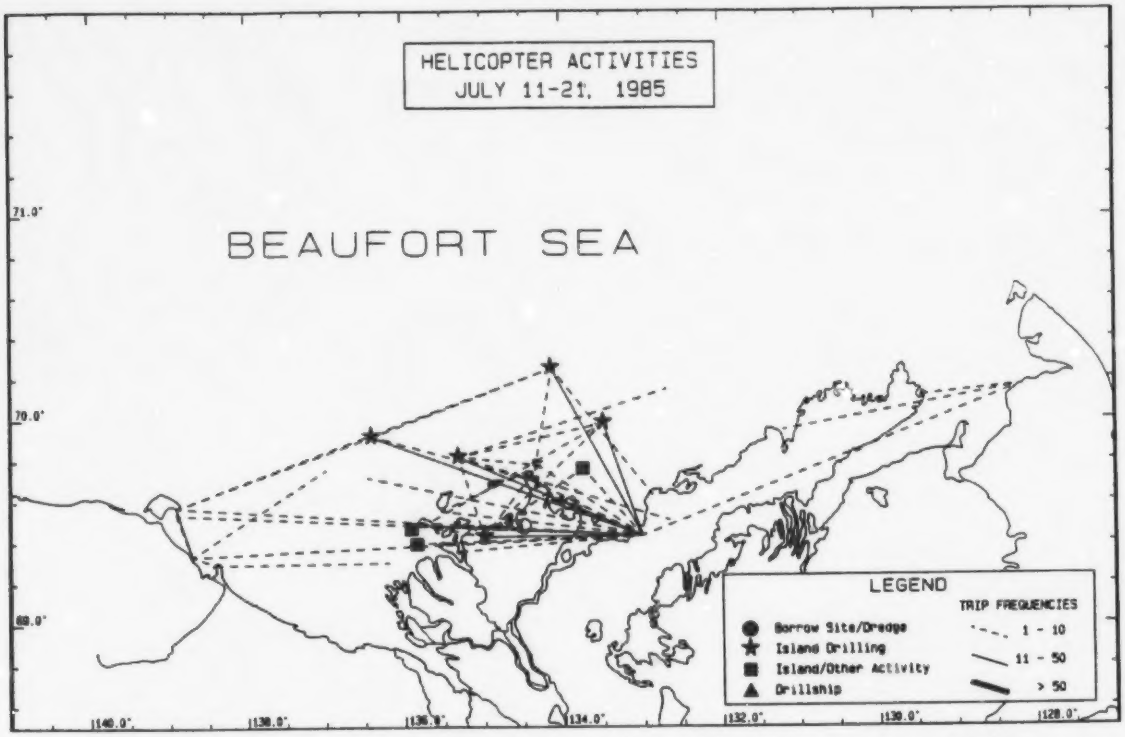
Map B.6-15: Vessel Activities September 11 to 20, 1985.


VESSEL ACTIVITIES
SEPTEMBER 21-30, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

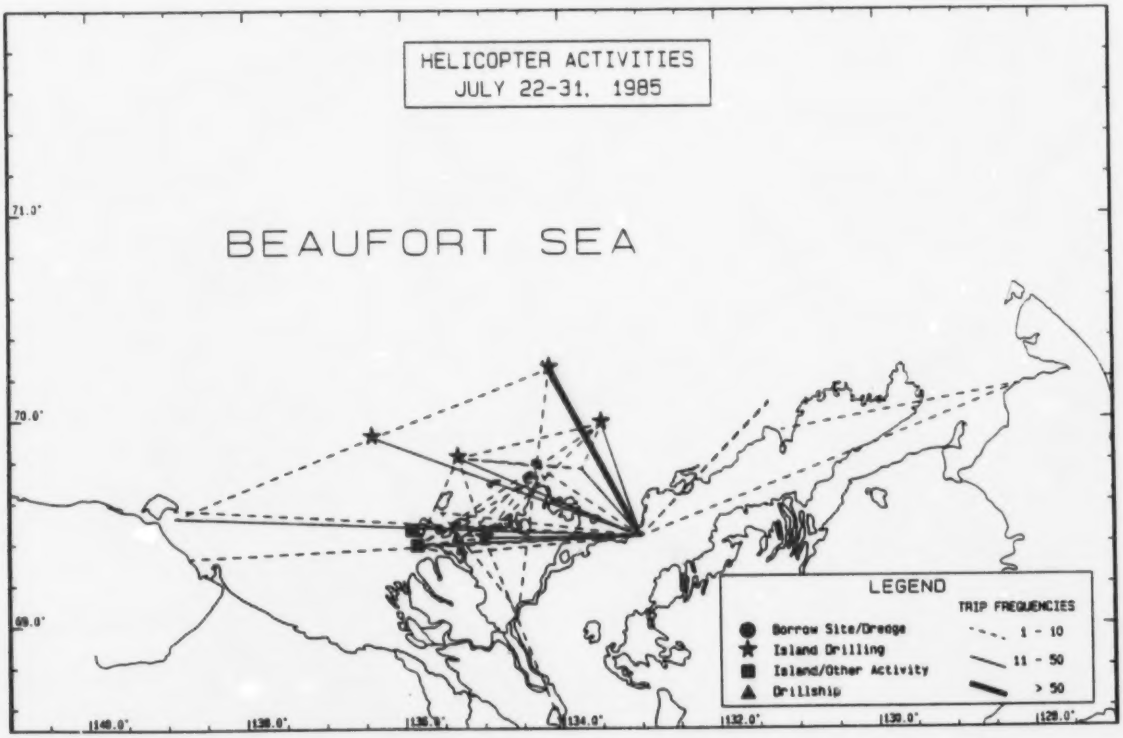
Map B.6-16: Vessel Activities September 21 to 30, 1985.


HELICOPTER ACTIVITIES
JULY 1-10, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
TRIP FREQUENCIES
1 - 10
11 - 50
> 50

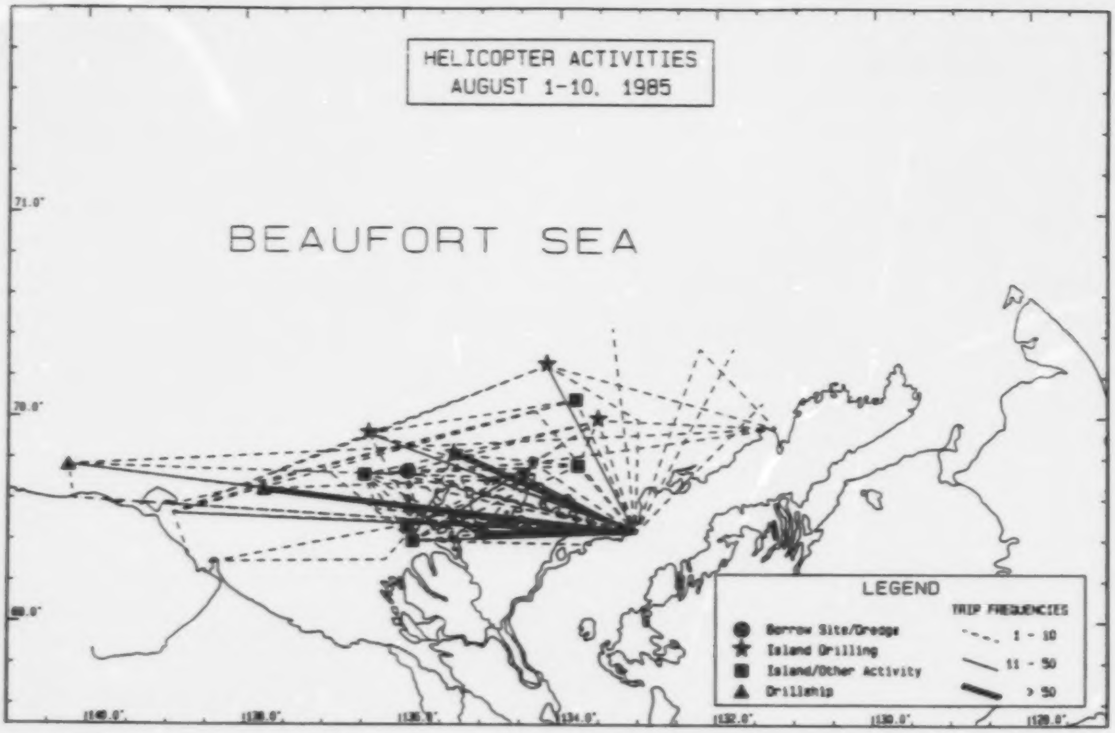
Map B.6-17: Helicopter Activities July 1 to 10, 1985.


HELICOPTER ACTIVITIES
JULY 11-21, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

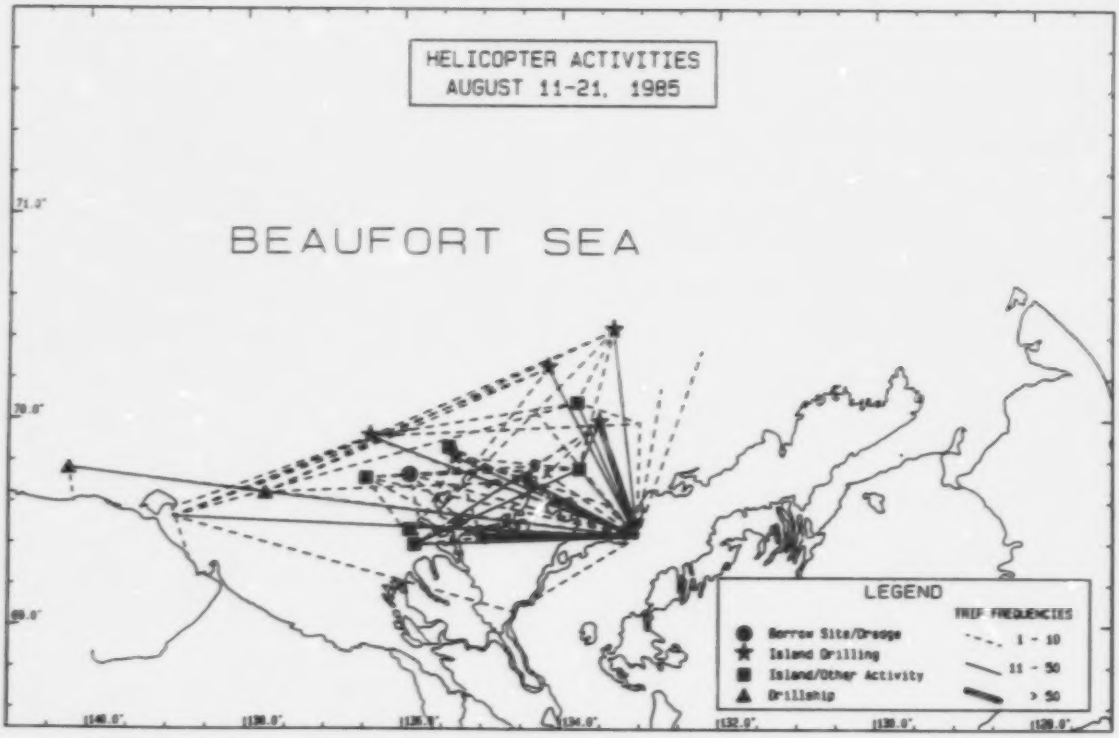
Map B.6-18: Helicopter Activities July 11 to 21, 1985.


HELICOPTER ACTIVITIES
JULY 22-31, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

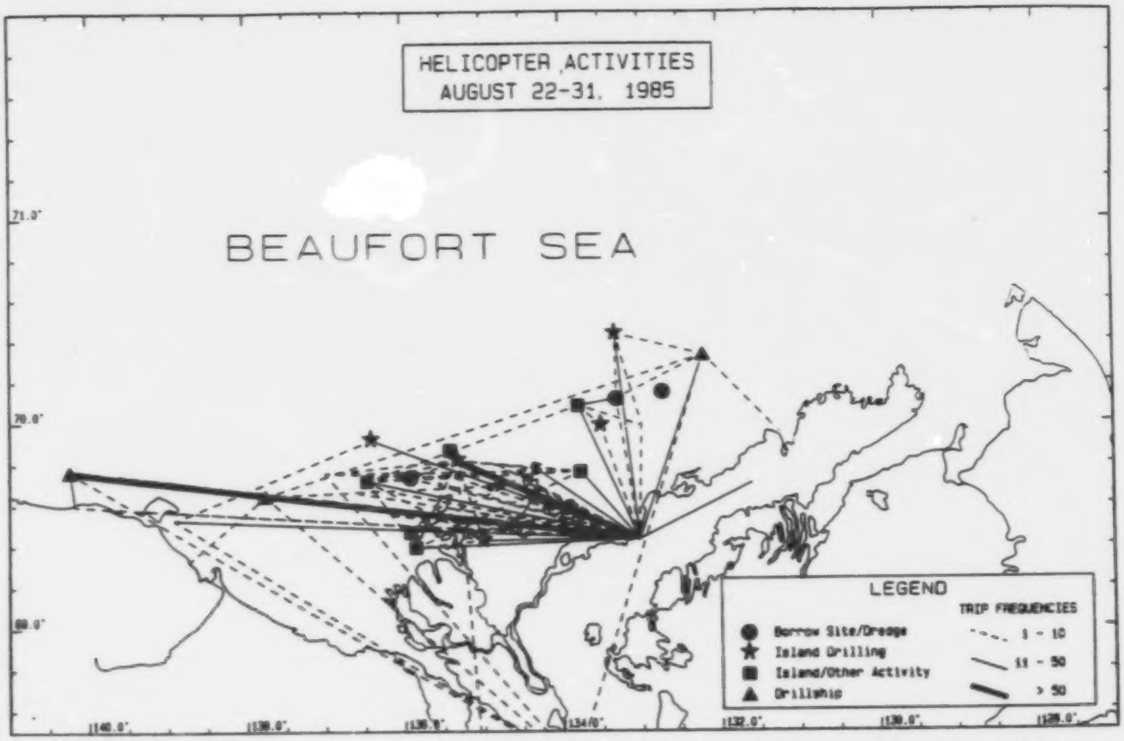
Map B.6-19: Helicopter Activities July 22 to 31, 1985.


HELICOPTER ACTIVITIES
AUGUST 1-10, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

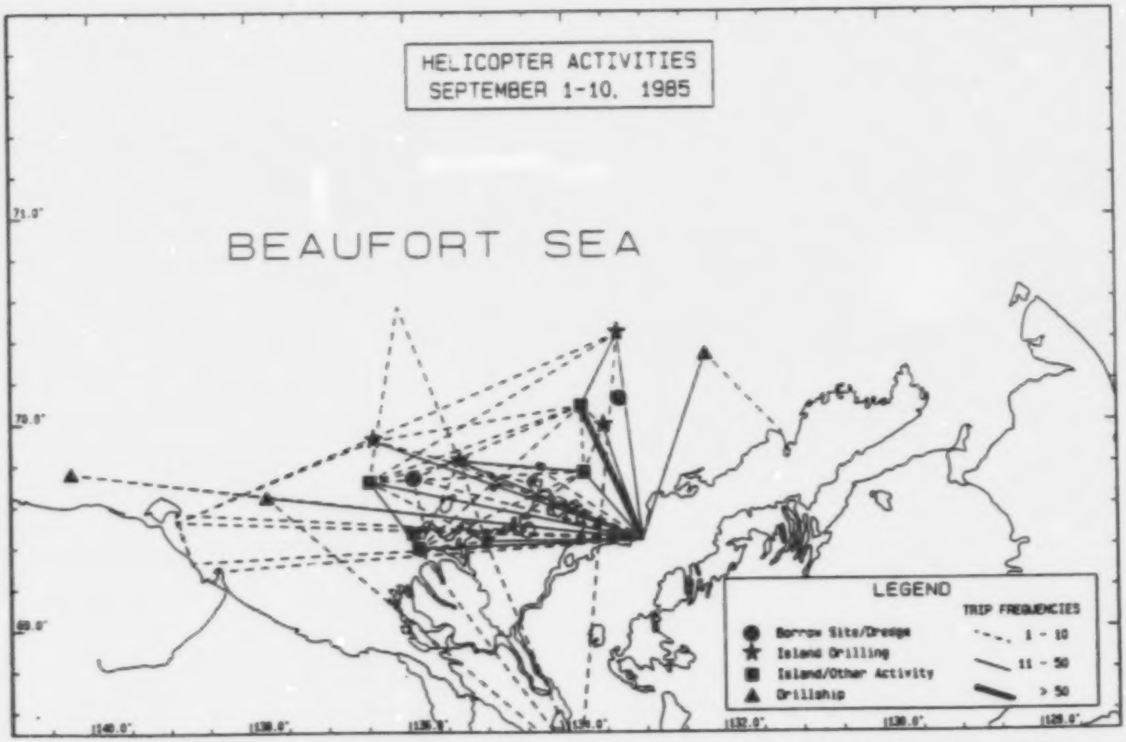
Map B.6-20: Helicopter Activities August 1 to 10, 1985.


HELICOPTER ACTIVITIES
AUGUST 11-21, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

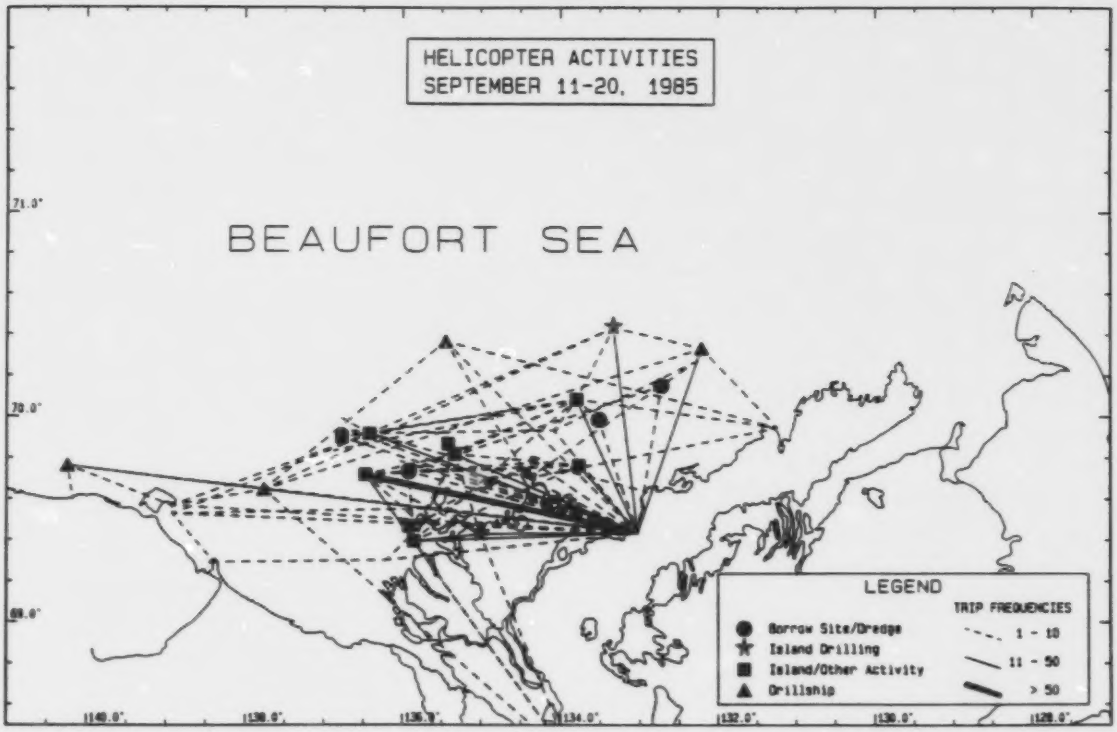
Map B.6-21: Helicopter Activities August 11 to 21, 1985.


HELICOPTER ACTIVITIES
AUGUST 22-31, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

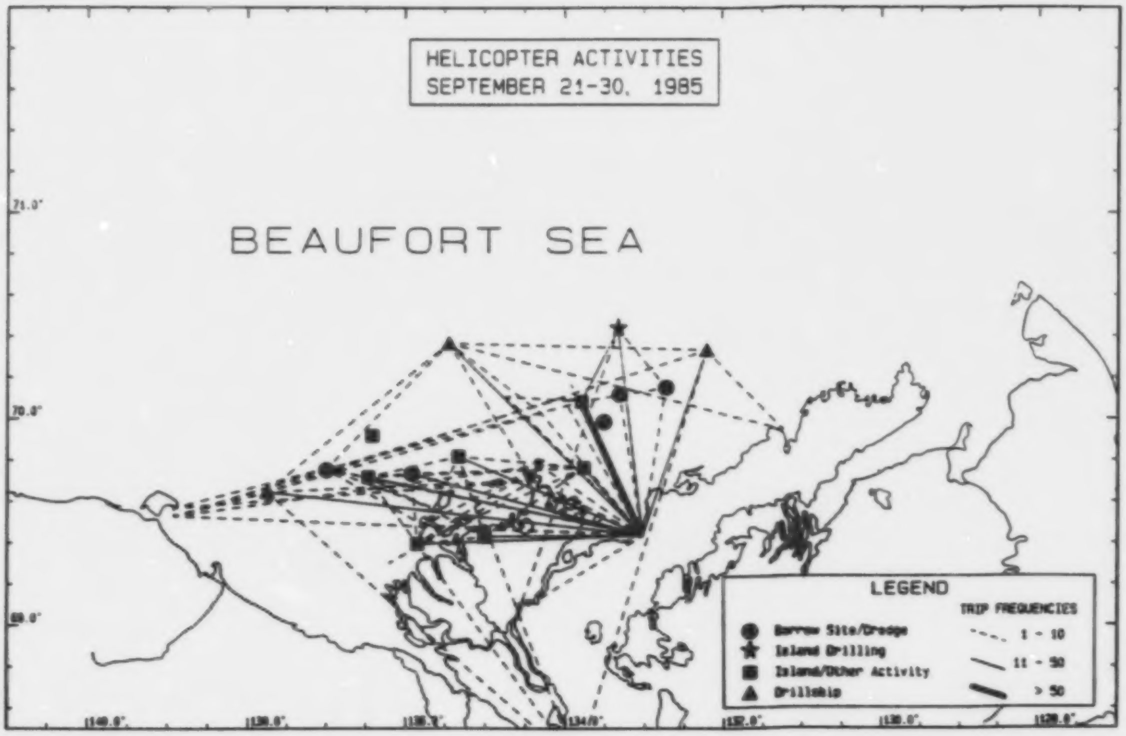
Map B.6-22: Helicopter Activities August 22 to 31, 1985.


HELICOPTER ACTIVITIES
SEPTEMBER 1-10, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

Map B.6-23: Helicopter Activities September 1 to 10, 1985.


HELICOPTER ACTIVITIES
SEPTEMBER 11-20, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

Map B.6-24: Helicopter Activities September 11 to 20, 1985.

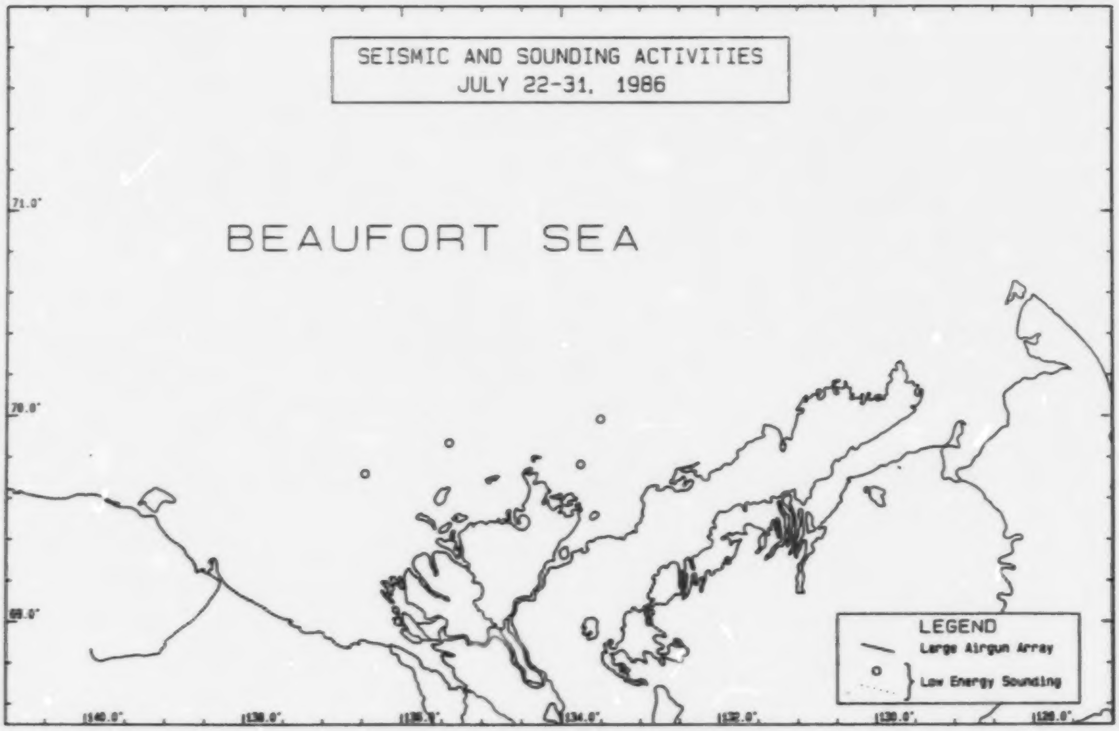

HELICOPTER ACTIVITIES
SEPTEMBER 21-30, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

Map B.6-25: Helicopter Activities September 21 to 30, 1985.

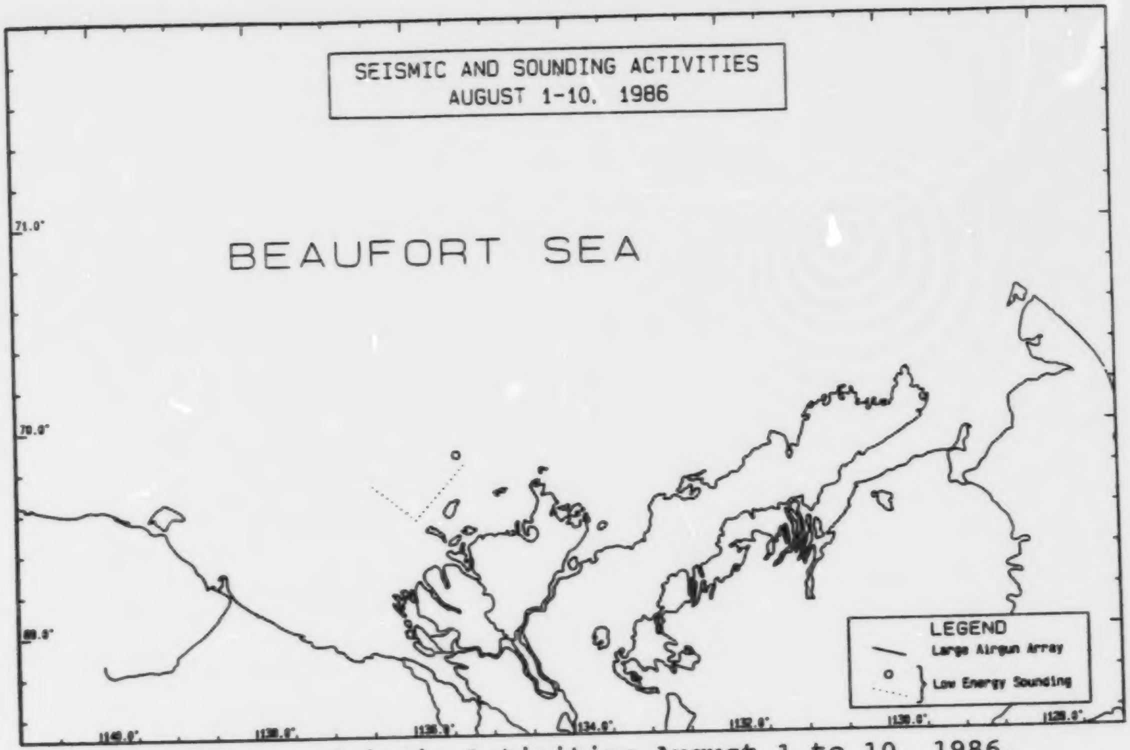
B.7 1986 INDUSTRIAL ACTIVITIES

The following section presents maps of:

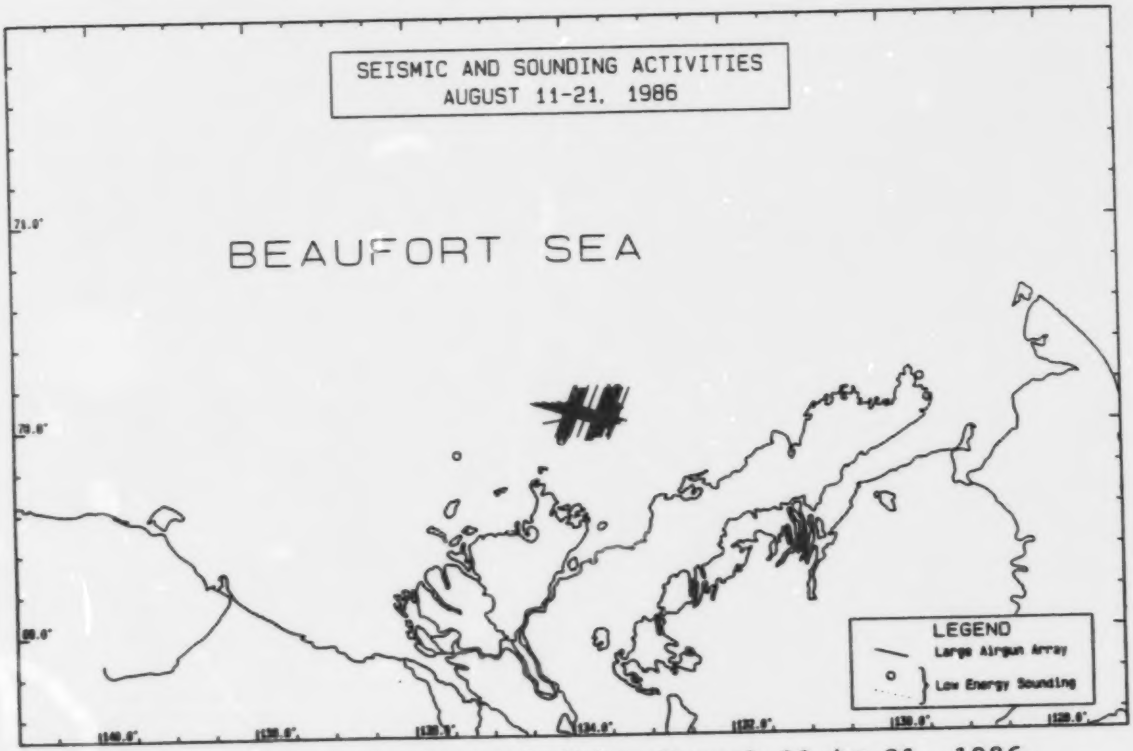
1) 1986 Seismic and Sounding Activities from July 22 to September 30,
2) 1986 Vessel Activities from July 1 to September 30, and
3) 1986 Helicopter Activities from July 1 to September 30.


SEISMIC AND SOUNDING ACTIVITIES
JULY 22-31, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Low Energy Sounding

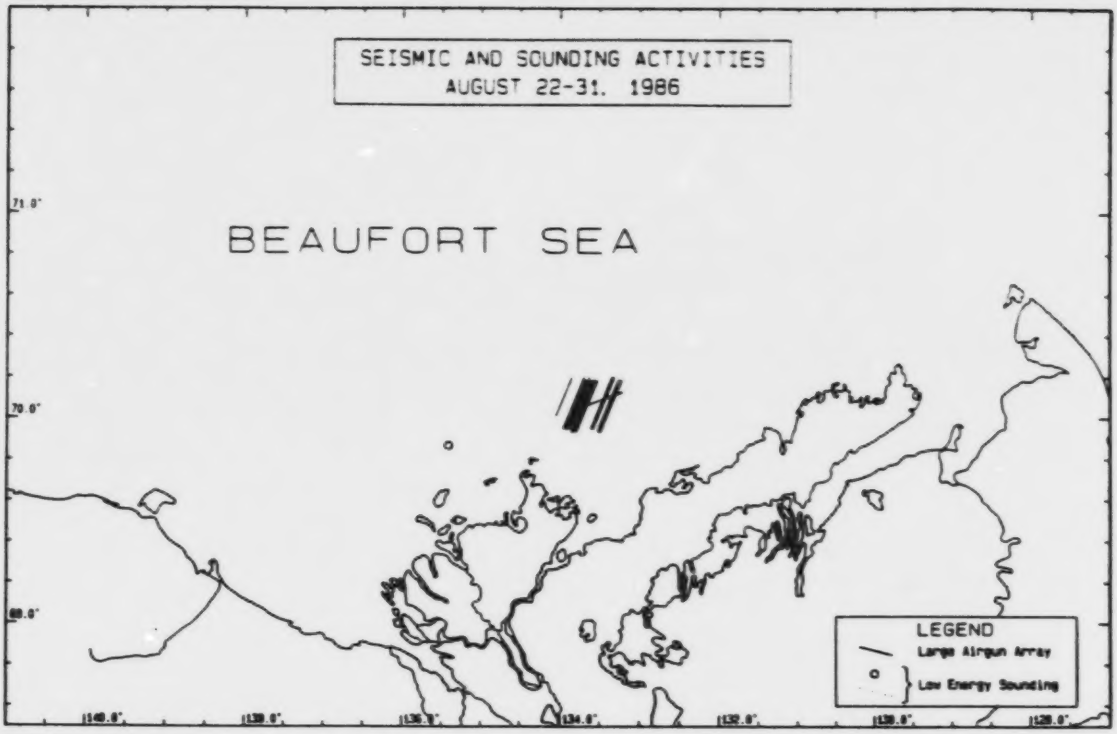
Map B.7-1: Seismic Activities July 22 to 31, 1986.


SEISMIC AND SOUNDING ACTIVITIES
AUGUST 1-10, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Low Energy Sounding

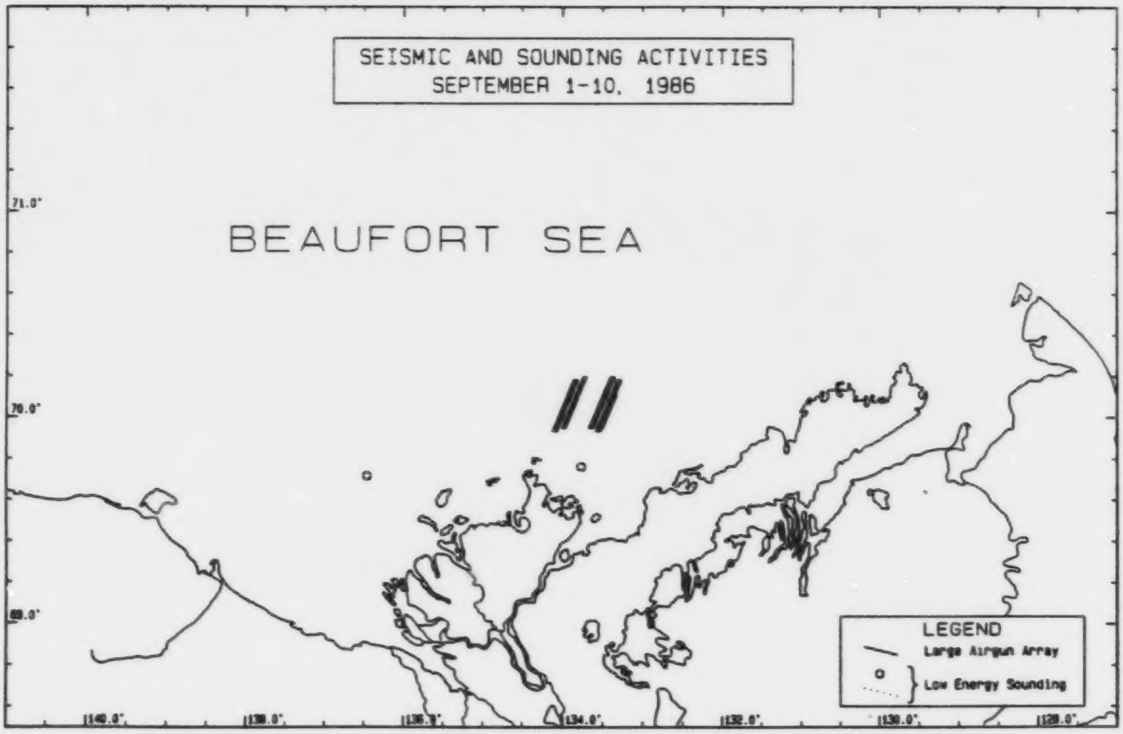
Map B.7-2: Seismic Activities August 1 to 10, 1986.


SEISMIC AND SOUNDING ACTIVITIES
AUGUST 11-21, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Low Energy Sounding

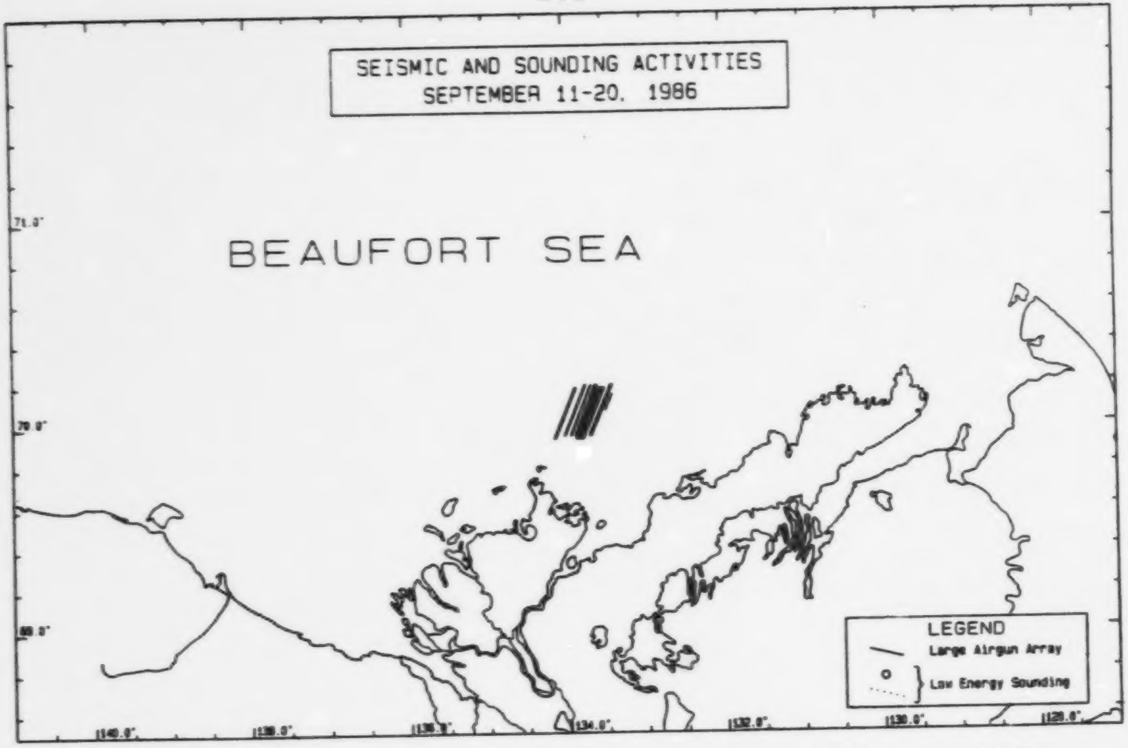
Map B.7-3: Seismic Activities August 11 to 21, 1986.


SEISMIC AND SOUNDING ACTIVITIES
AUGUST 22-31, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Low Energy Sounding

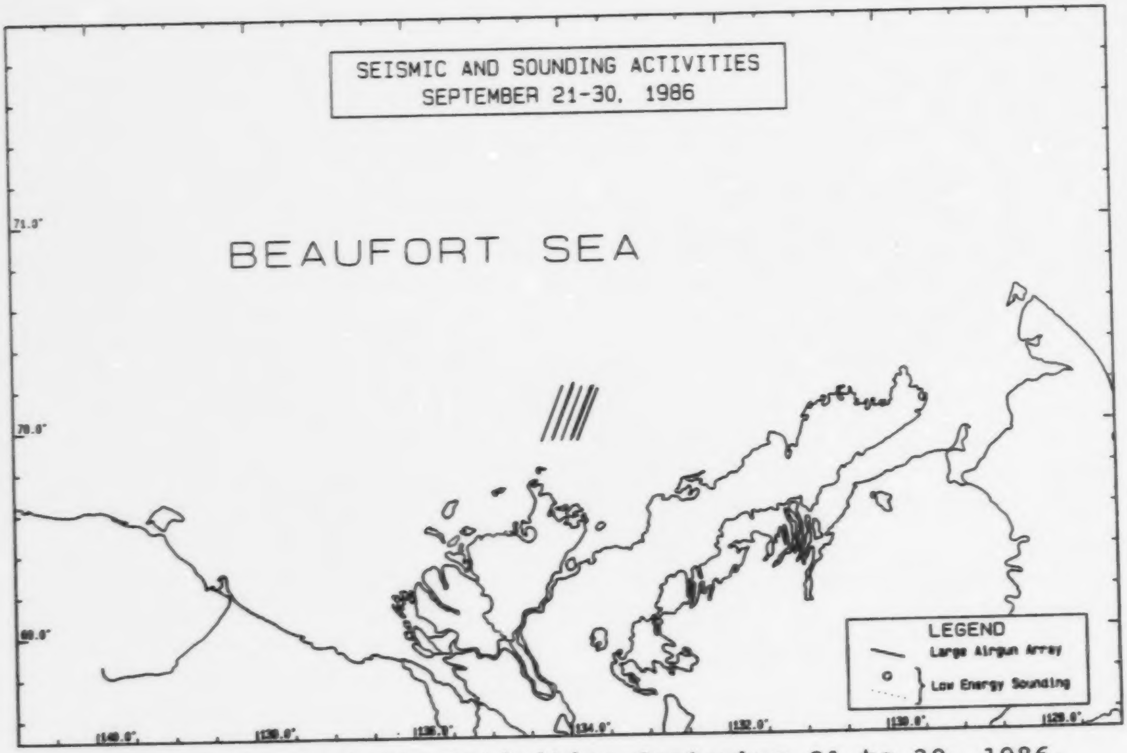
Map B.7-4: Seismic Activities August 22 to 31, 1986.


SEISMIC AND SOUNDING ACTIVITIES
SEPTEMBER 1-10, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Low Energy Sounding

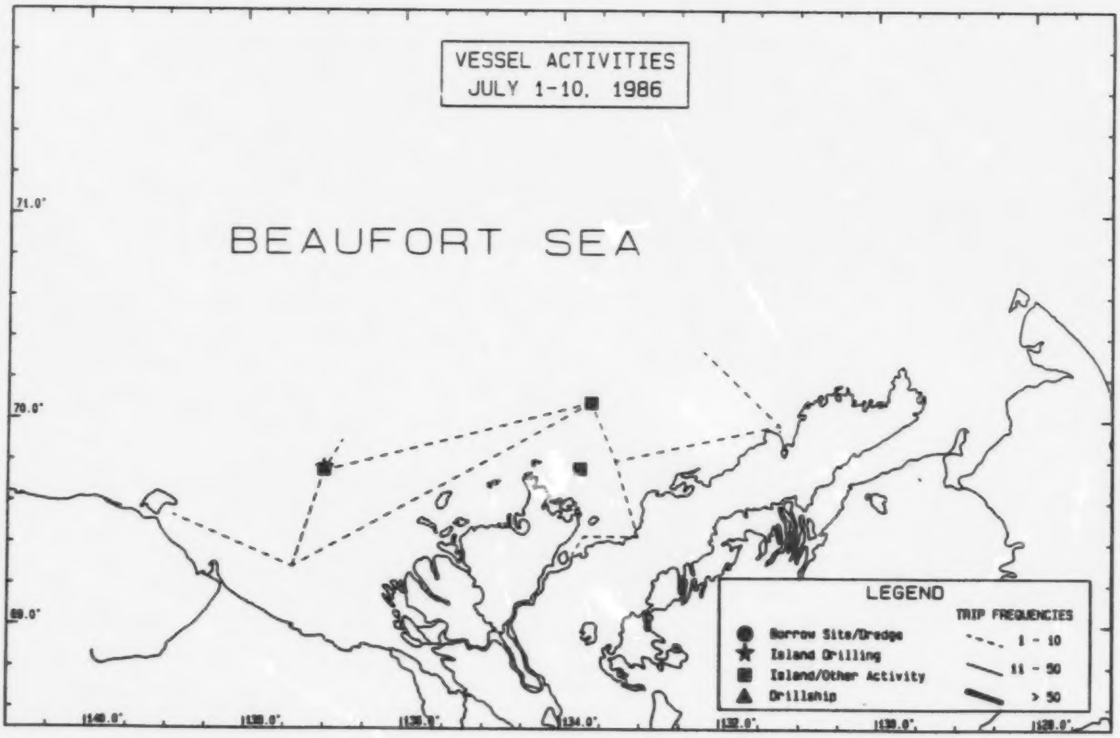
Map B.7-5: Seismic Activities September 1 to 10, 1986.


SEISMIC AND SOUNDING ACTIVITIES
SEPTEMBER 11-20, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Low Energy Sounding

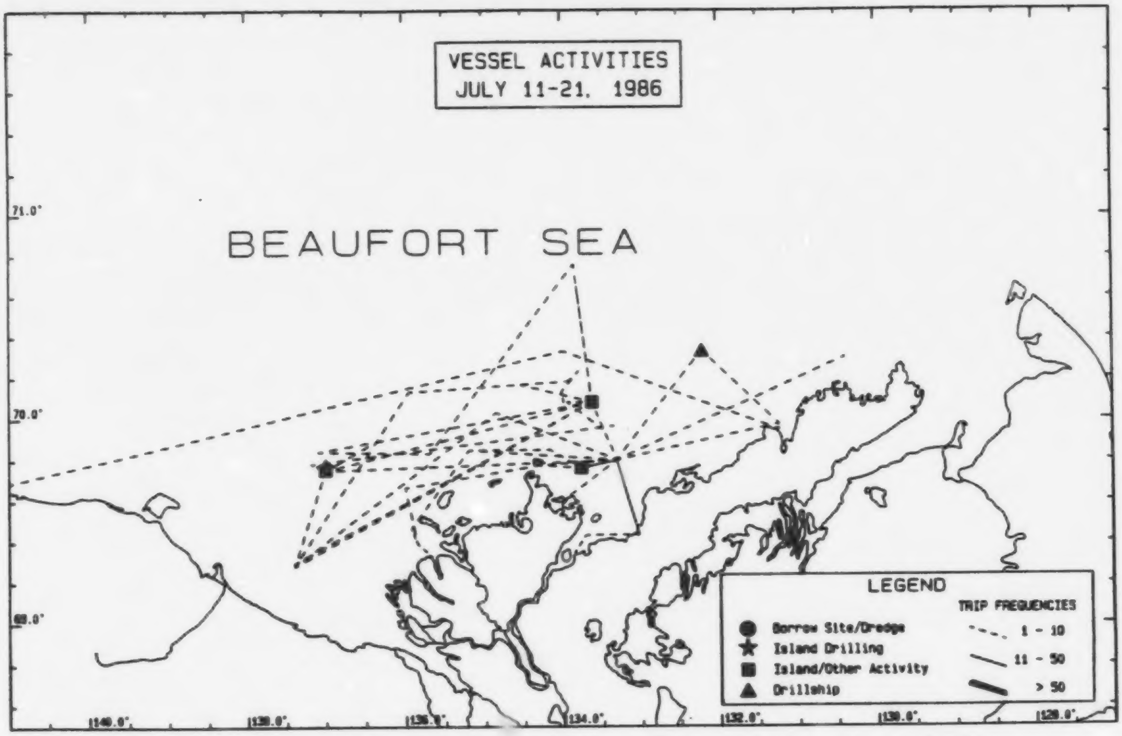
Map B.7-6: Seismic Activities September 11 to 20, 1986.


SEISMIC AND SOUNDING ACTIVITIES
SEPTEMBER 21-30, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Low Energy Sounding

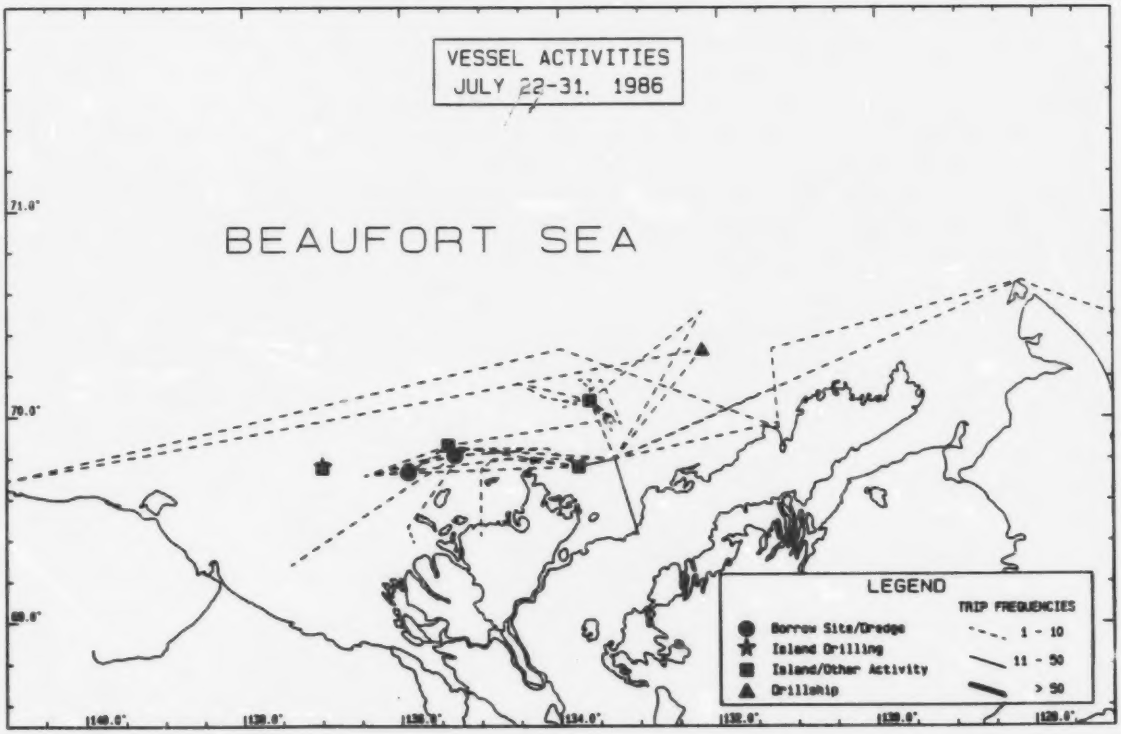
Map B.7-7: Seismic Activities September 21 to 30, 1986.


VESSEL ACTIVITIES
JULY 1-10, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
TRIP FREQUENCIES
1 - 10
11 - 50
> 50

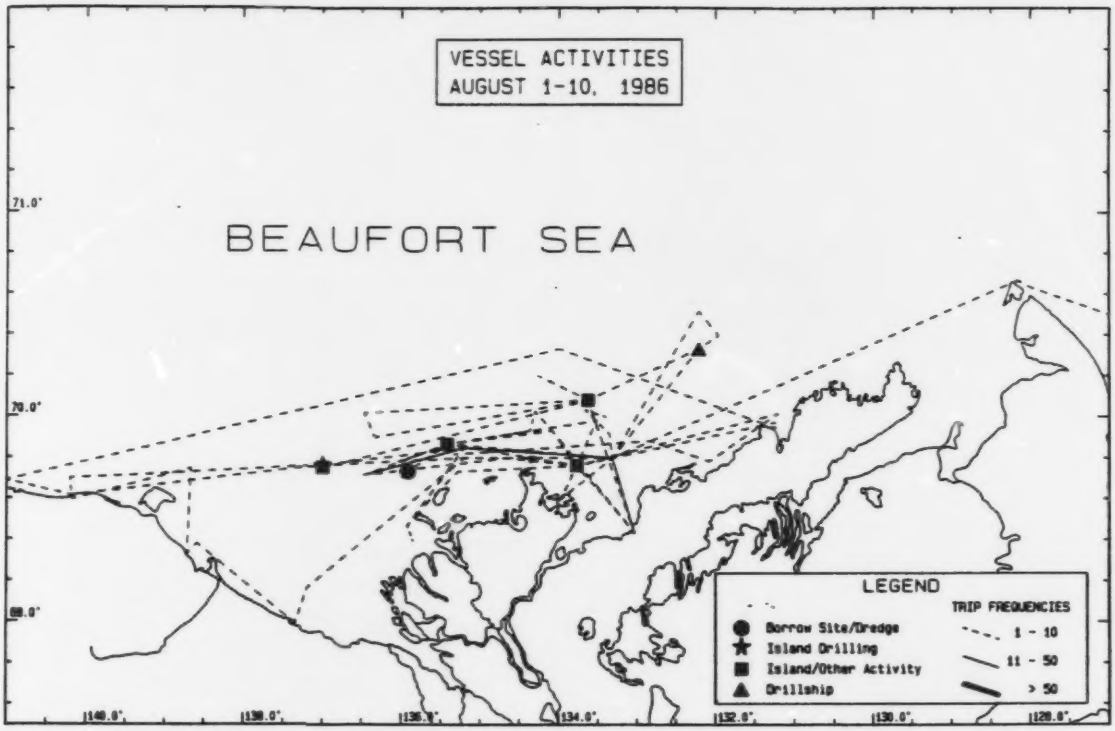
Map B.7-8: Vessel Activities July 1 to 10, 1986.


VESSEL ACTIVITIES
JULY 11-21, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

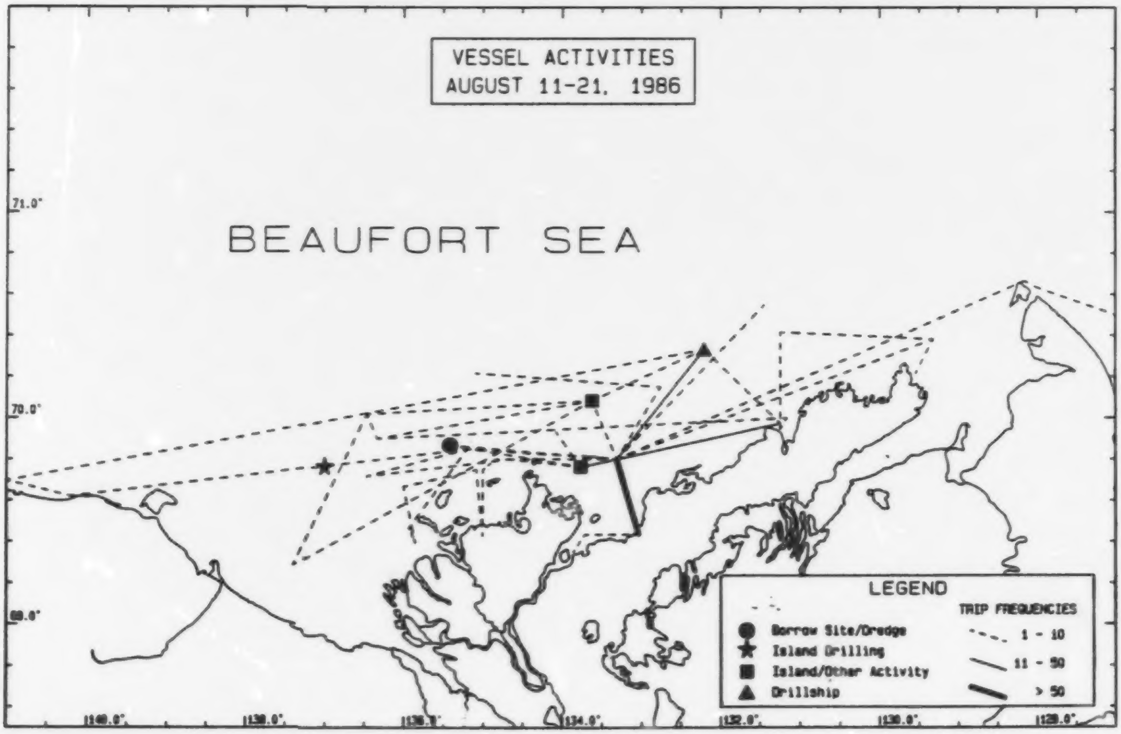
Map B.7-9: Vessel Activities July 11 to 21, 1986.


VESSEL ACTIVITIES
JULY 22-31, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

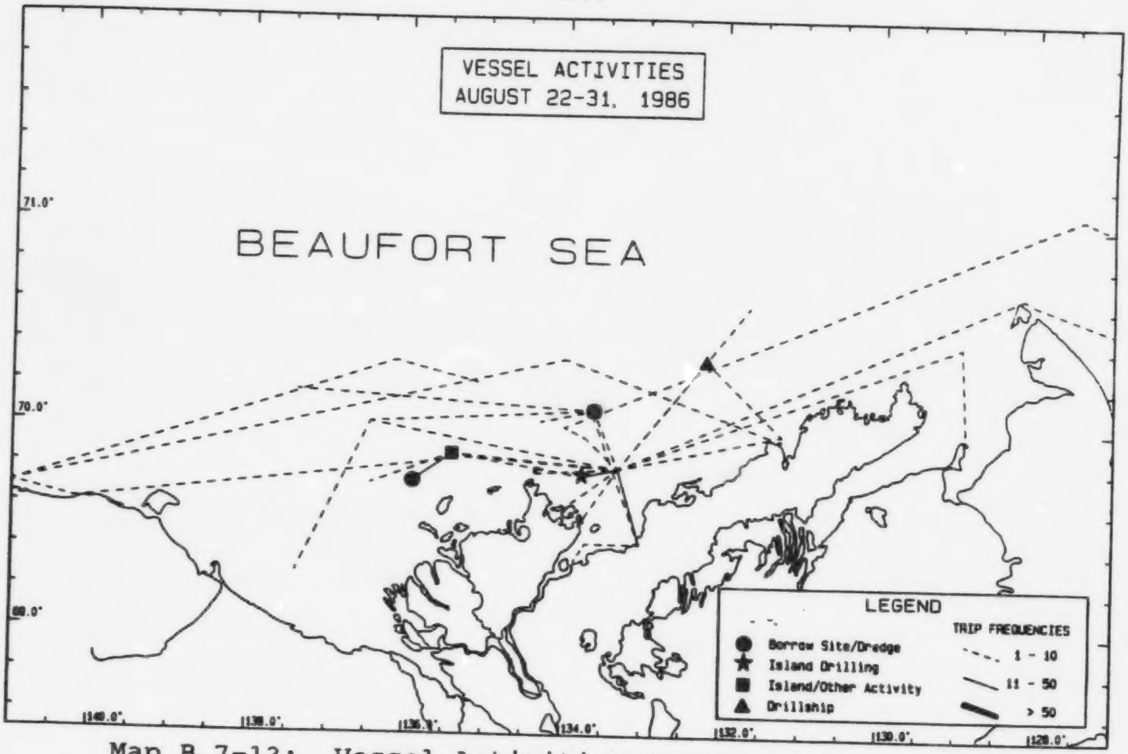
Map B.7-10: Vessel Activities July 22 to 31, 1986.


VESSEL ACTIVITIES
AUGUST 1-10, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

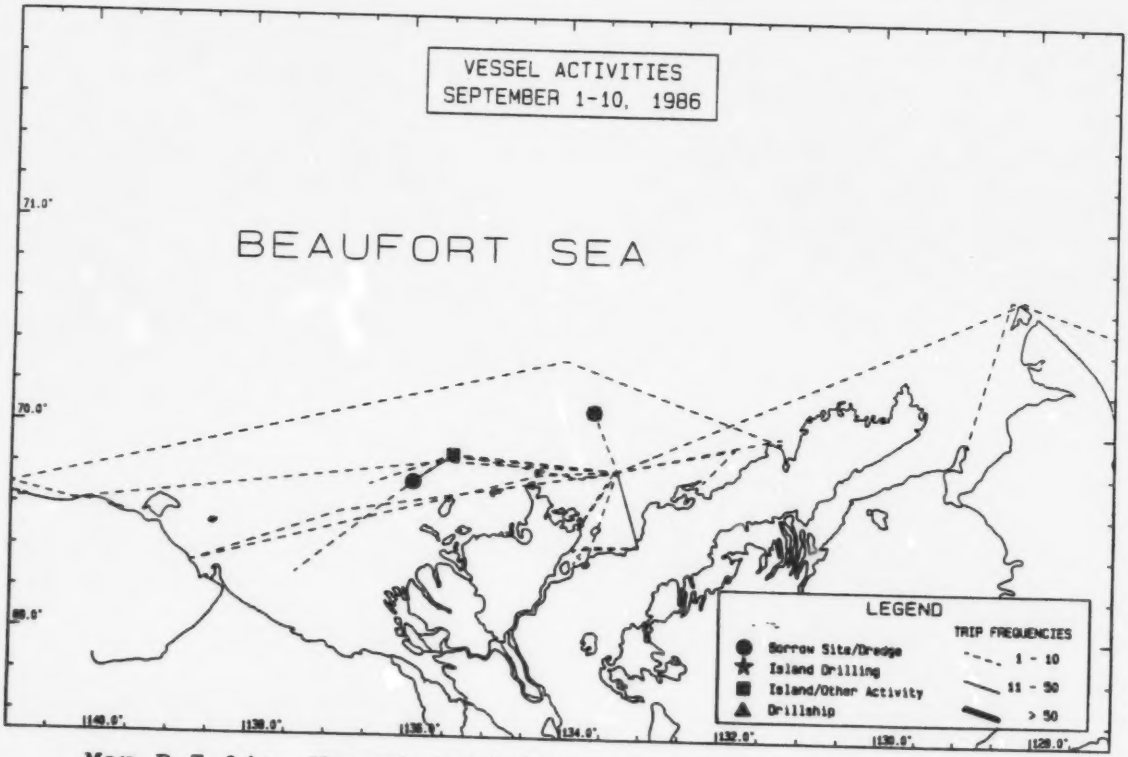
Map B.7-11: Vessel Activities August 1 to 10, 1986.


VESSEL ACTIVITIES
AUGUST 11-21, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

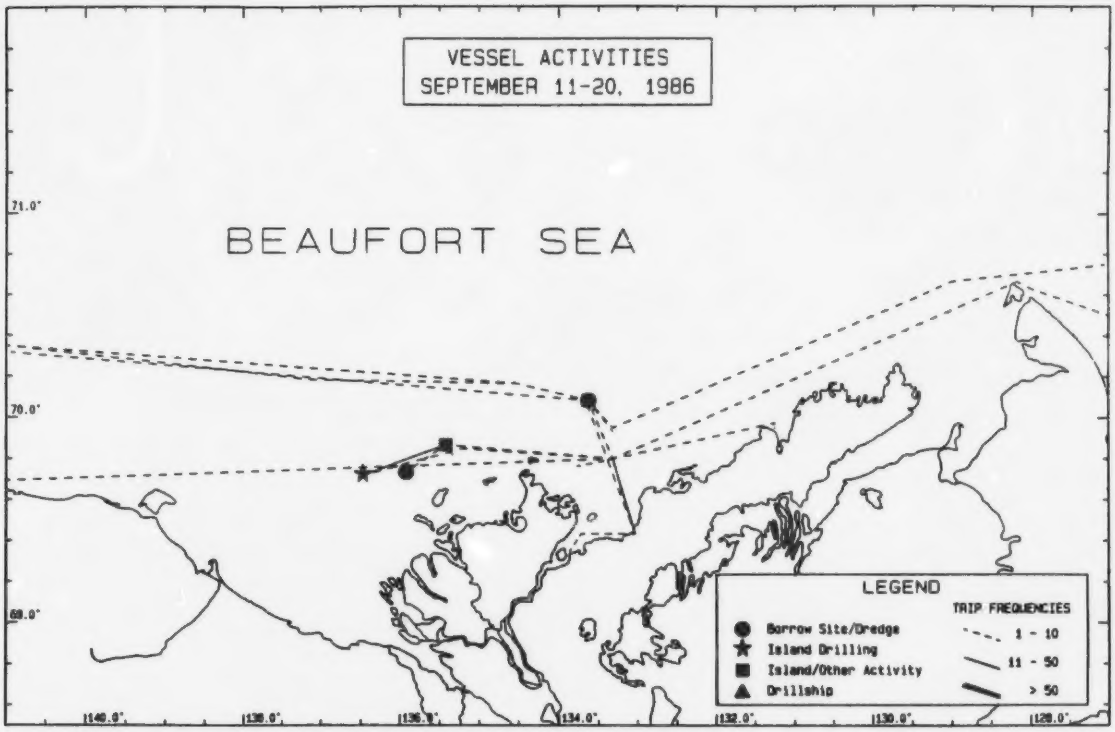
Map B.7-12: Vessel Activities August 11 to 21, 1986.


VESSEL ACTIVITIES
AUGUST 22-31, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

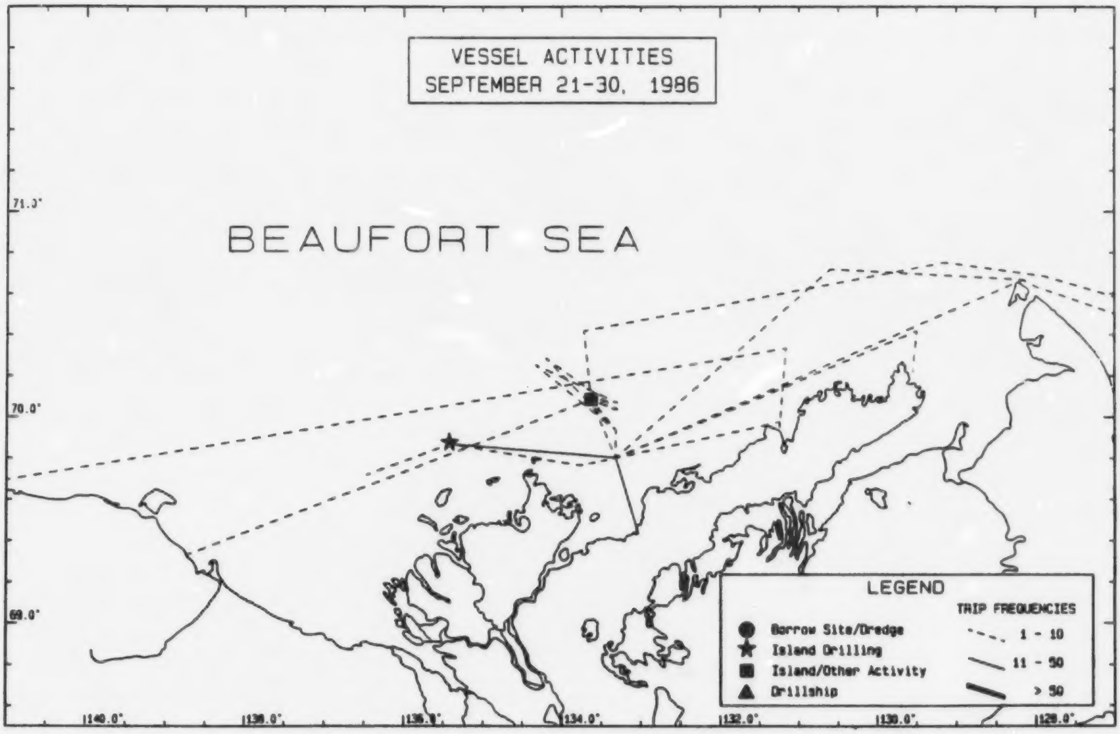
Map B.7-13: Vessel Activities August 22 to 31, 1986.


VESSEL ACTIVITIES
SEPTEMBER 1-10, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

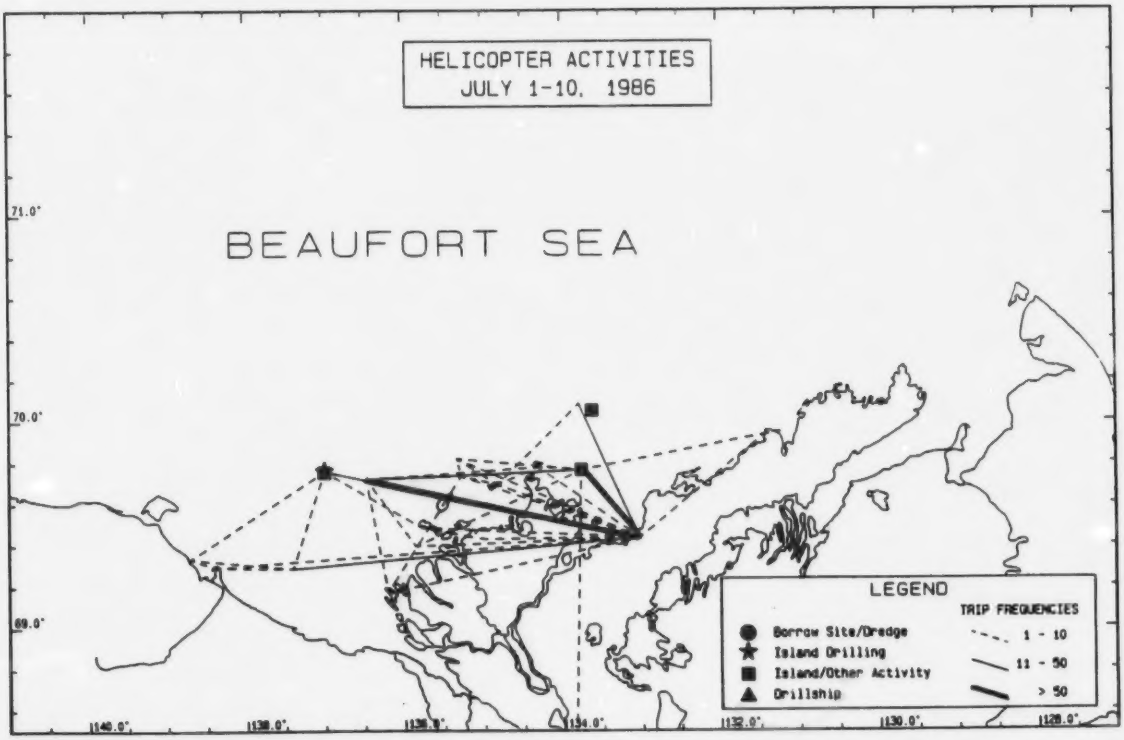
Map B.7-14: Vessel Activities September 1 to 10, 1986.


VESSEL ACTIVITIES
SEPTEMBER 11-20, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

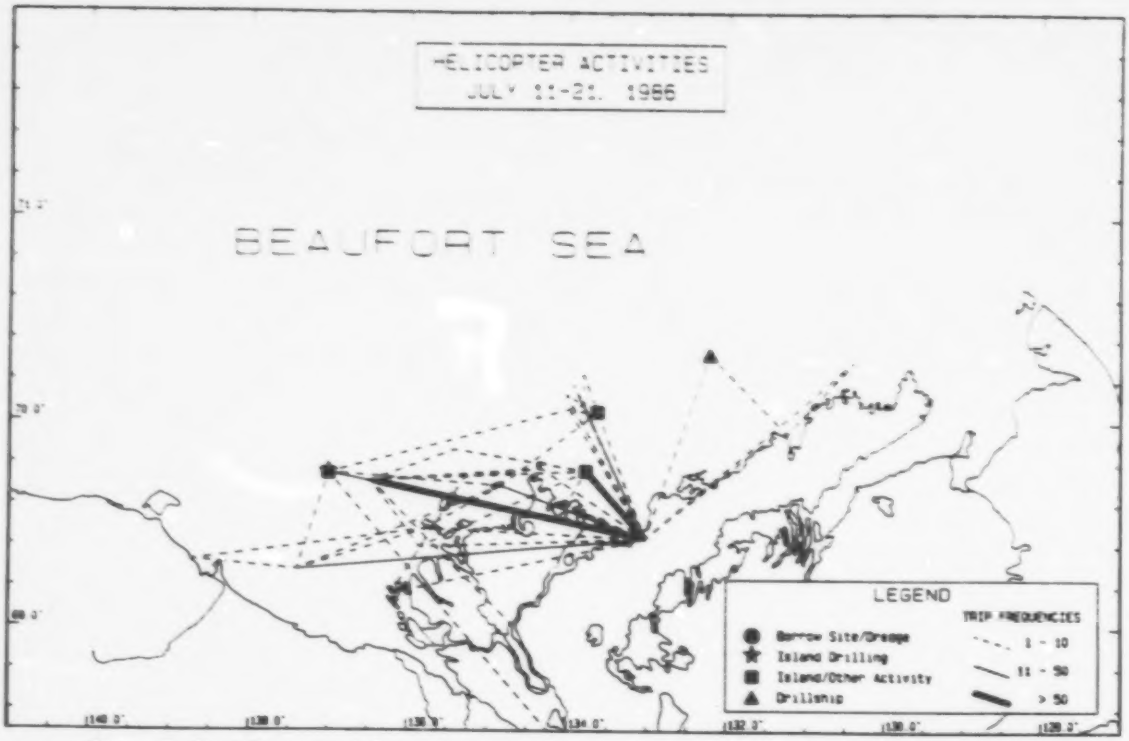
Map B.7-15: Vessel Activities September 11 to 20, 1986.


VESSEL ACTIVITIES
SEPTEMBER 21-30, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

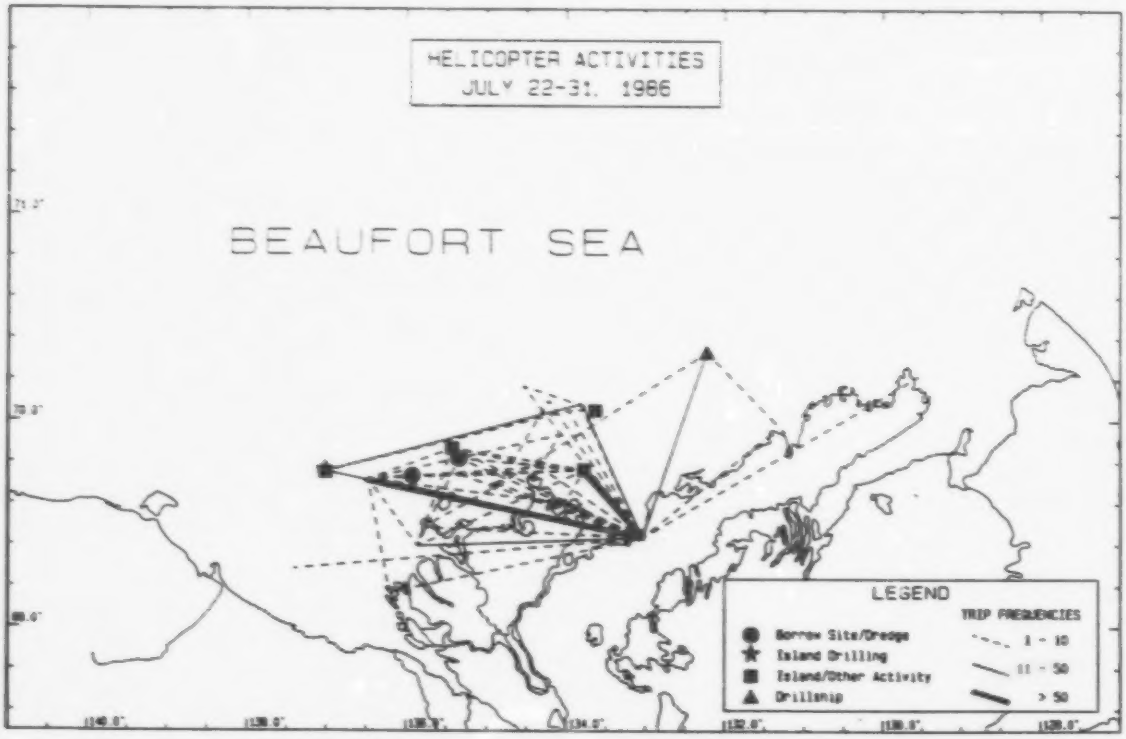
Map B.7-16: Vessel Activities September 21 to 30, 1986.


HELICOPTER ACTIVITIES
JULY 1-10, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

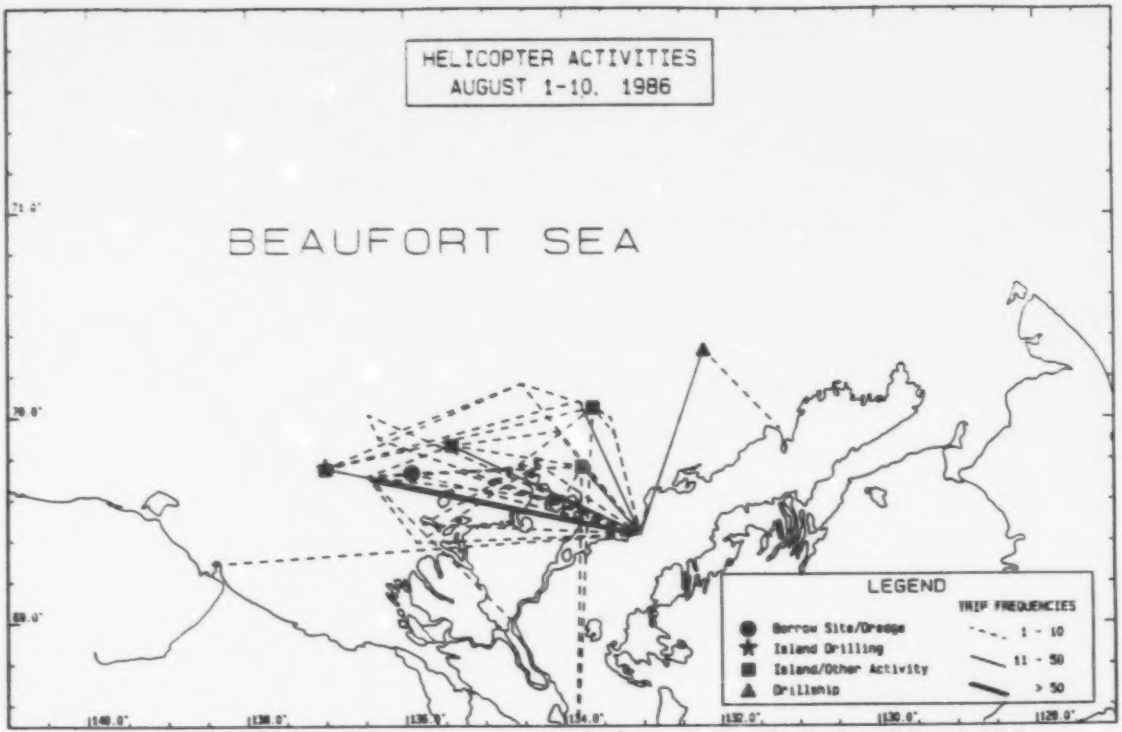
Map B.7-17: Helicopter Activities July 1 to 10, 1986.


HELICOPTER ACTIVITIES
JULY 11-21, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

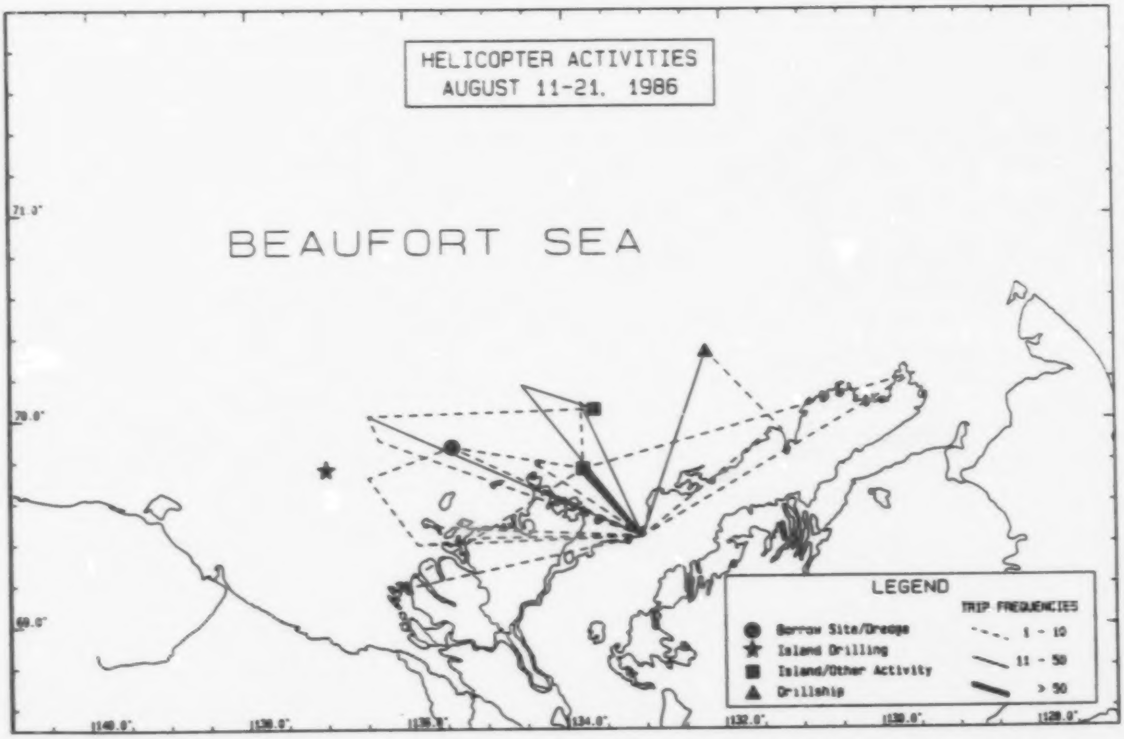
Map B.7-18: Helicopter Activities July 11 to 21, 1986.


HELICOPTER ACTIVITIES
JULY 22-31, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

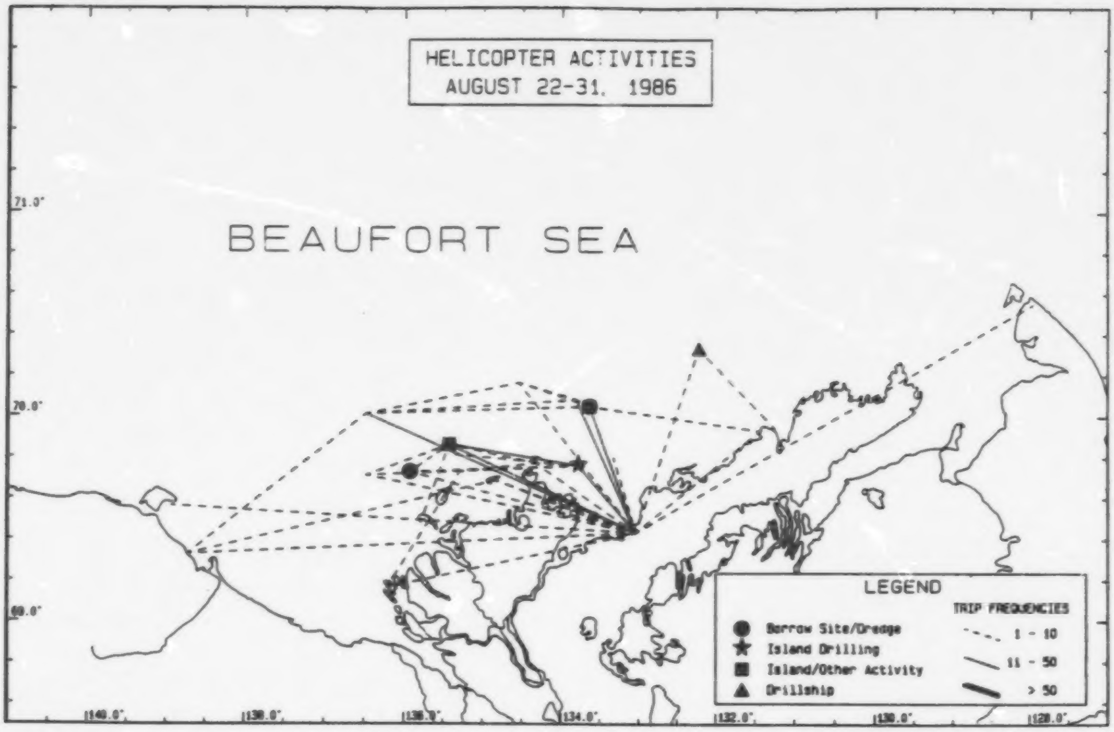
Map B.7-19: Helicopter Activities July 22 to 31, 1986.


HELICOPTER ACTIVITIES
AUGUST 1-10, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

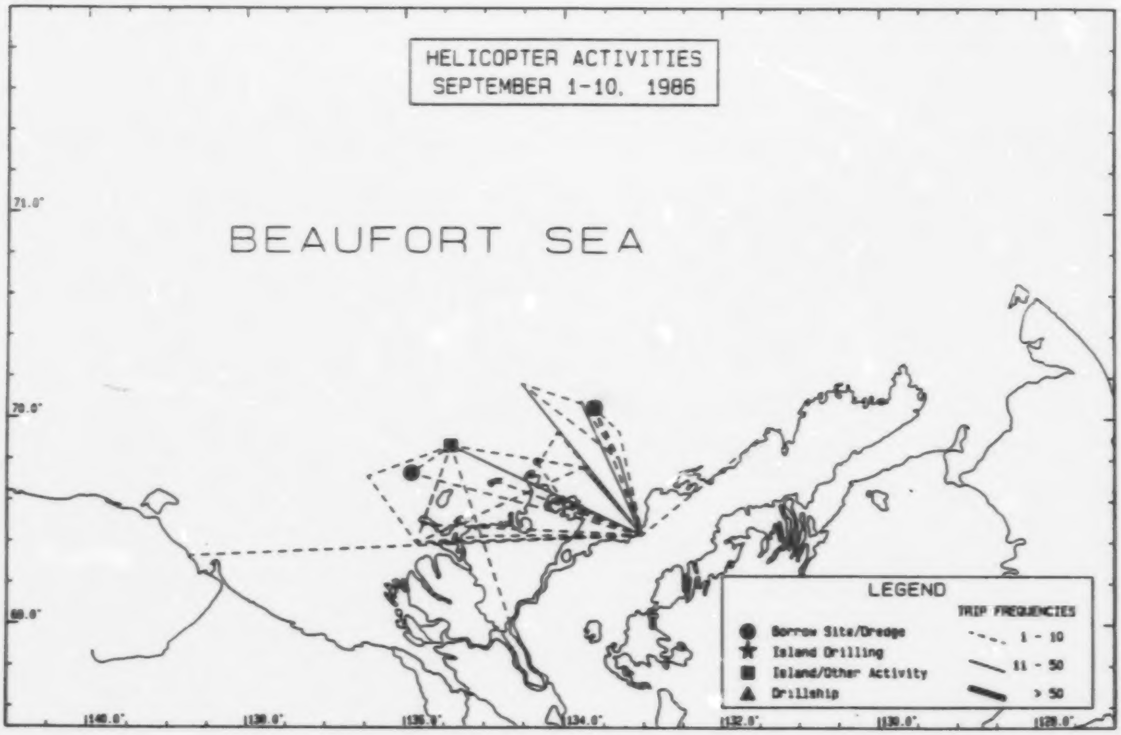
Map B.7-20: Helicopter Activities August 1 to 10, 1986.


HELICOPTER ACTIVITIES
AUGUST 11-21, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

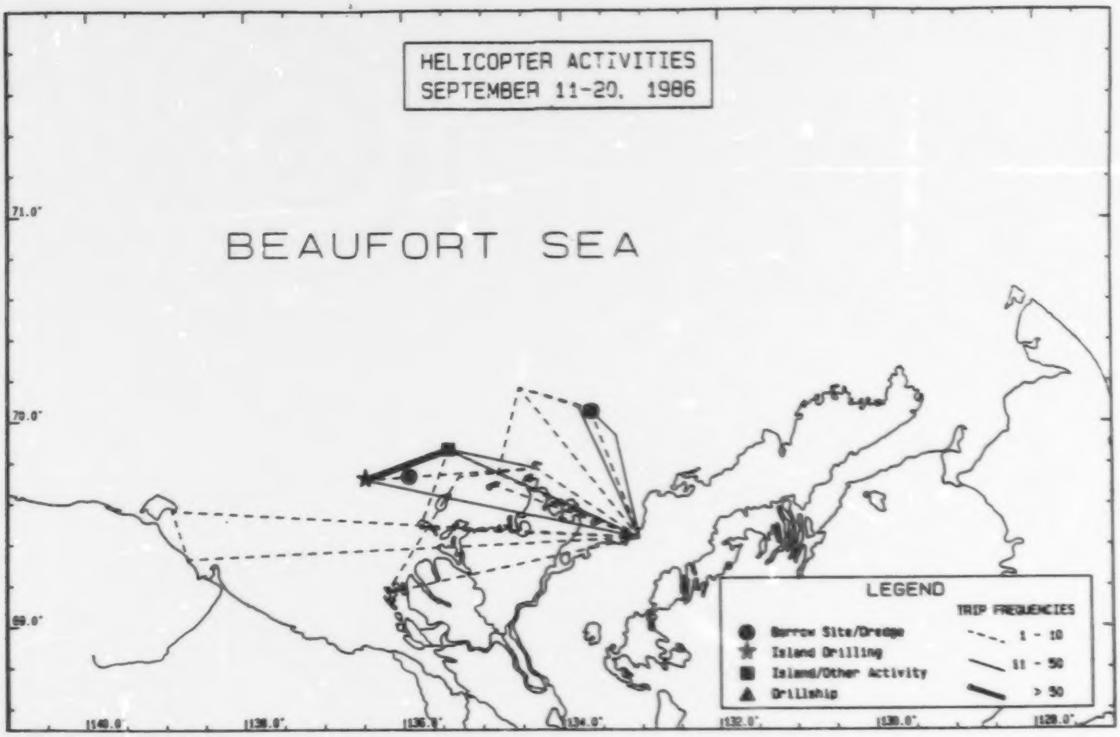
Map B.7-21: Helicopter Activities August 11 to 21, 1986.


HELICOPTER ACTIVITIES
AUGUST 22-31, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

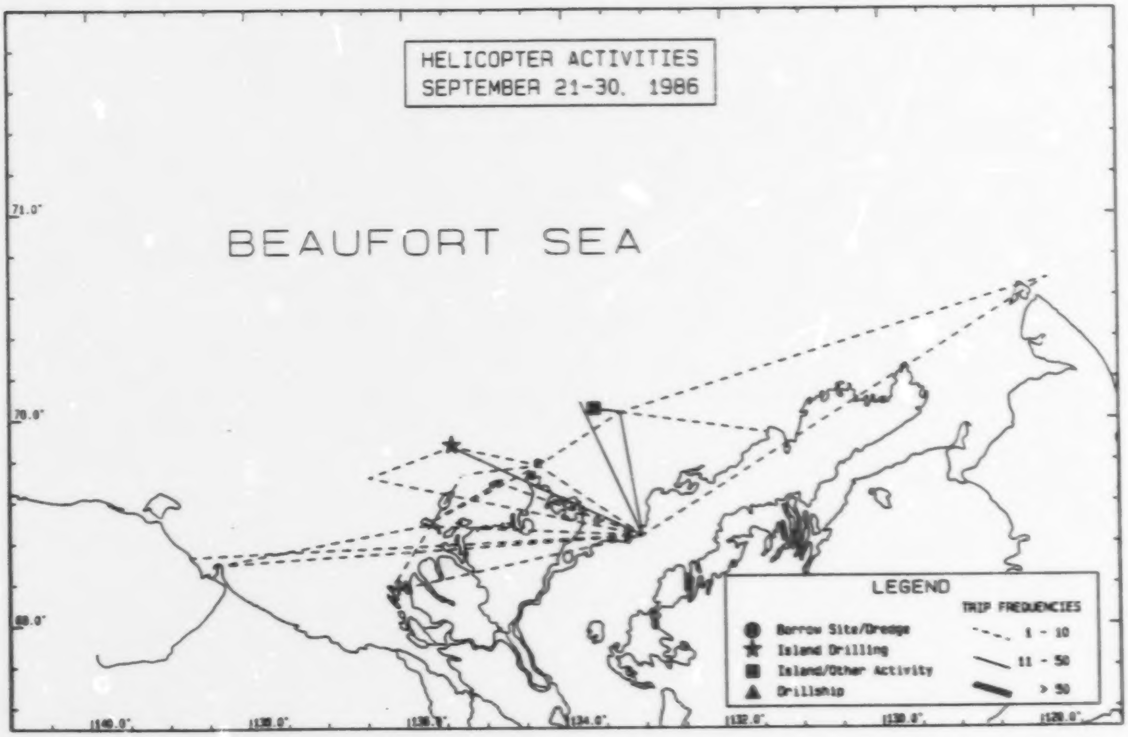
Map B.7-22: Helicopter Activities August 22 to 31, 1986.


HELICOPTER ACTIVITIES
SEPTEMBER 1-10, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

Map B.7-23: Helicopter Activities September 1 to 10, 1986.


HELICOPTER ACTIVITIES
SEPTEMBER 11-20, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

Map B.7-24: Helicopter Activities September 11 to 20, 1986.


HELICOPTER ACTIVITIES
SEPTEMBER 21-30, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

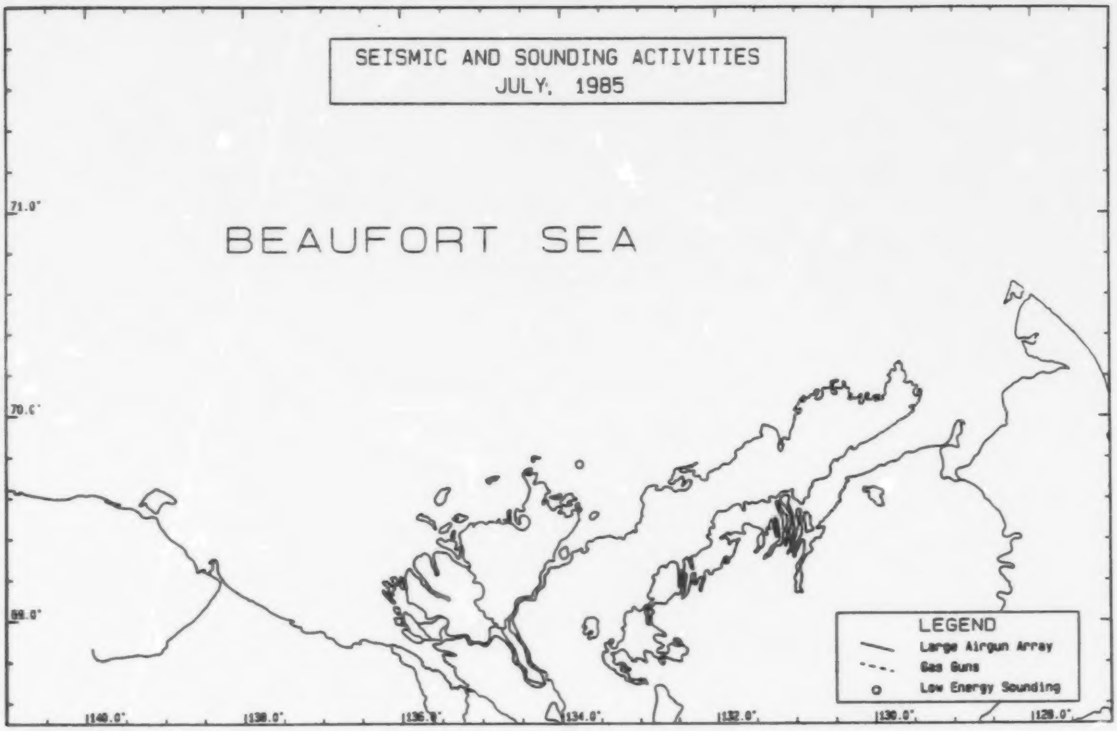
Map B.7-25: Helicopter Activities September 21 to 30, 1986.

APPENDIX C

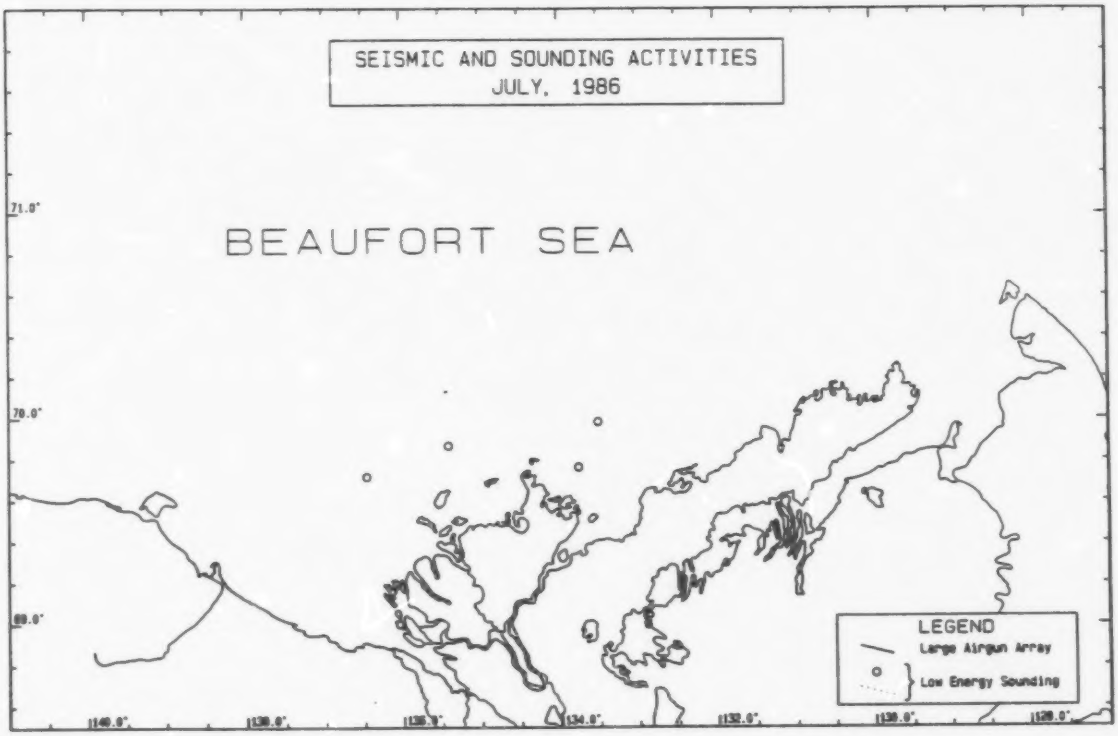
MAPS OF MONTHLY INDUSTRIAL ACTIVITIES FOR 1985 AND 1986

BY

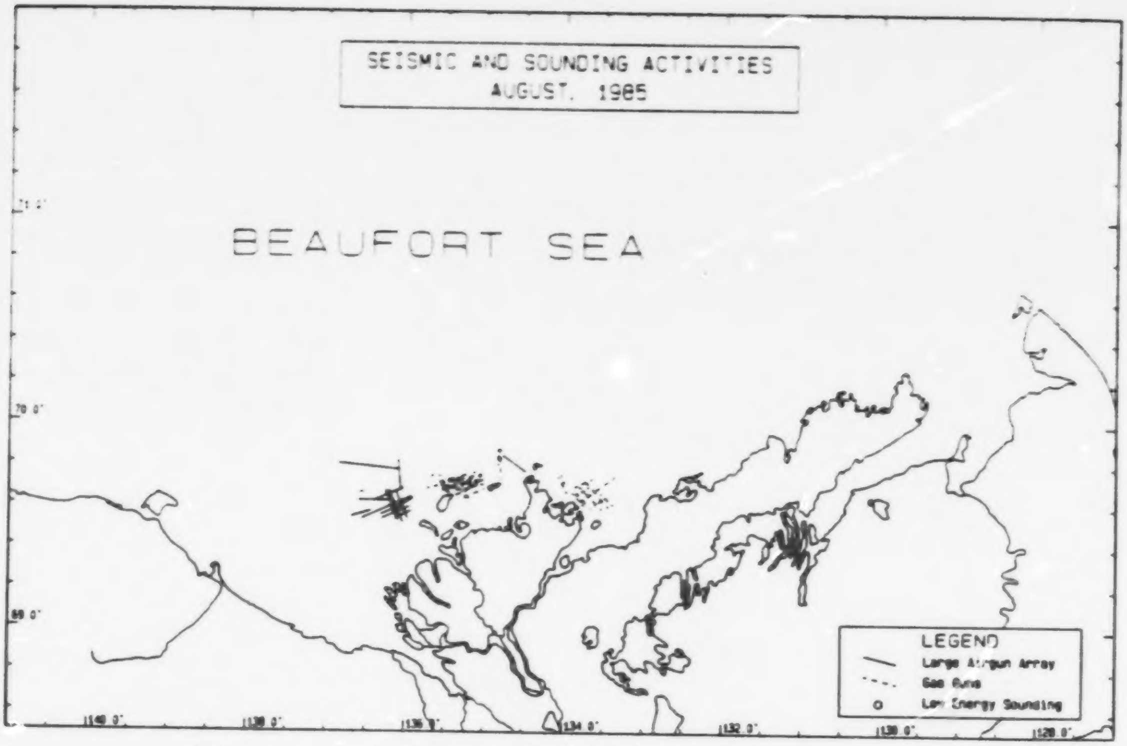
ACTIVITY TYPE


SEISMIC AND SOUNDING ACTIVITIES
JULY, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
LEGEND
Large Airgun Array
Gas Guns
Low Energy Sounding
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

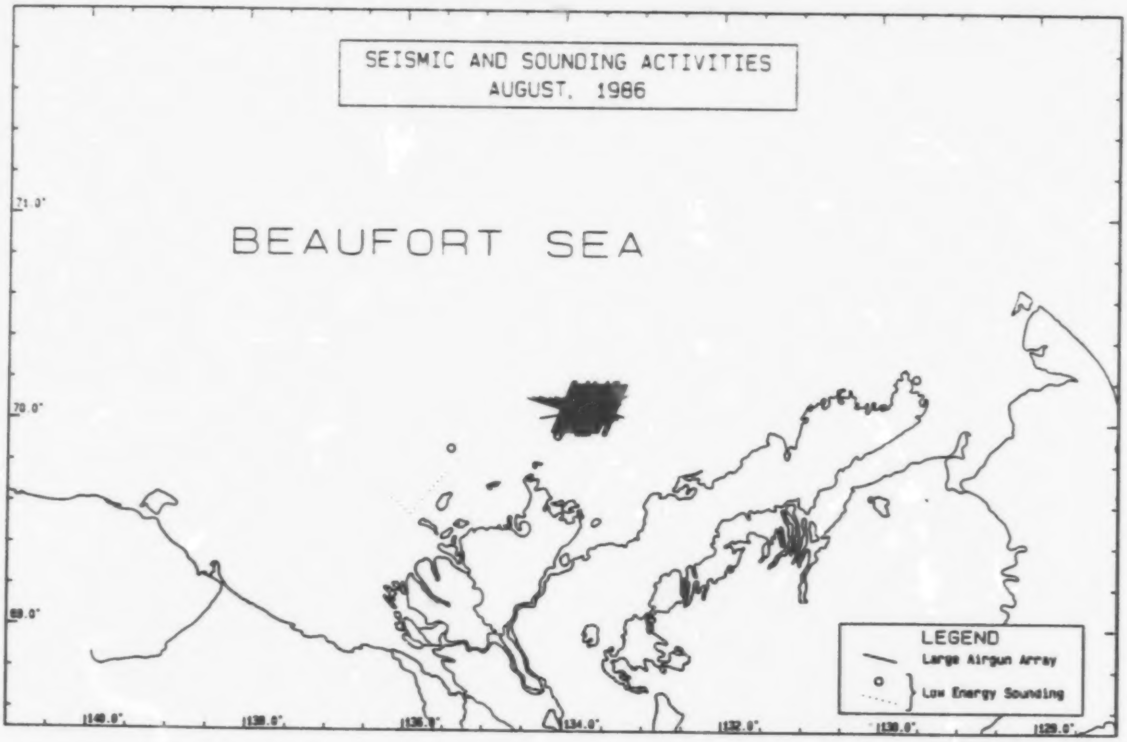
Map C-1: Seismic Activities, July 1985.


SEISMIC AND SOUNDING ACTIVITIES
JULY, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
LEGEND
Large Airgun Array
Low Energy Sounding
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

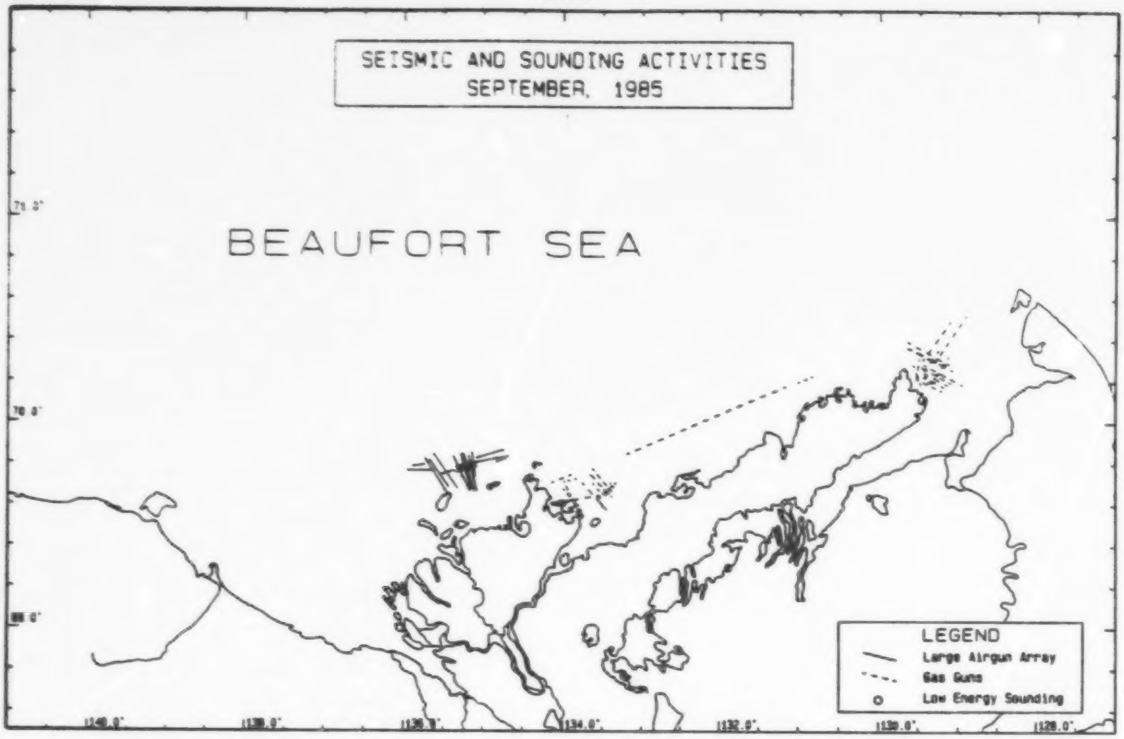
Map C-2: Seismic Activities, July 1986.


SEISMIC AND SOUNDING ACTIVITIES
AUGUST, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Gas Guns
Low Energy Sounding

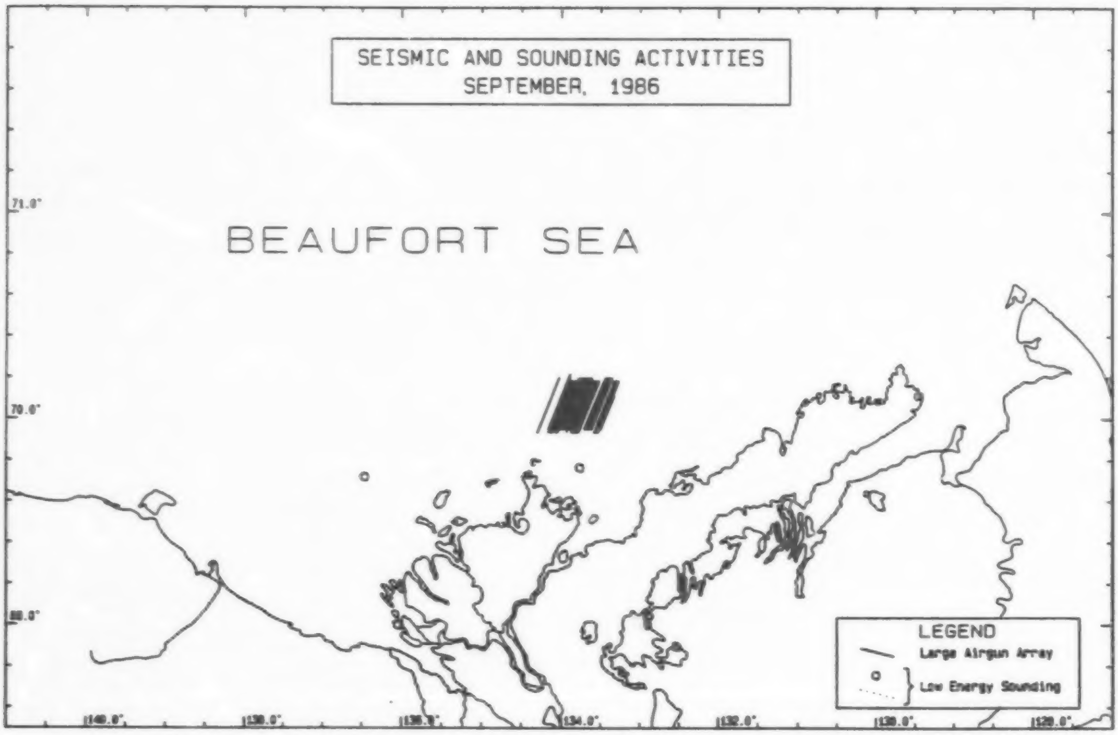
Map C-3: Seismic Activities, August 1985.


SEISMIC AND SOUNDING ACTIVITIES
AUGUST, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Low Energy Sounding

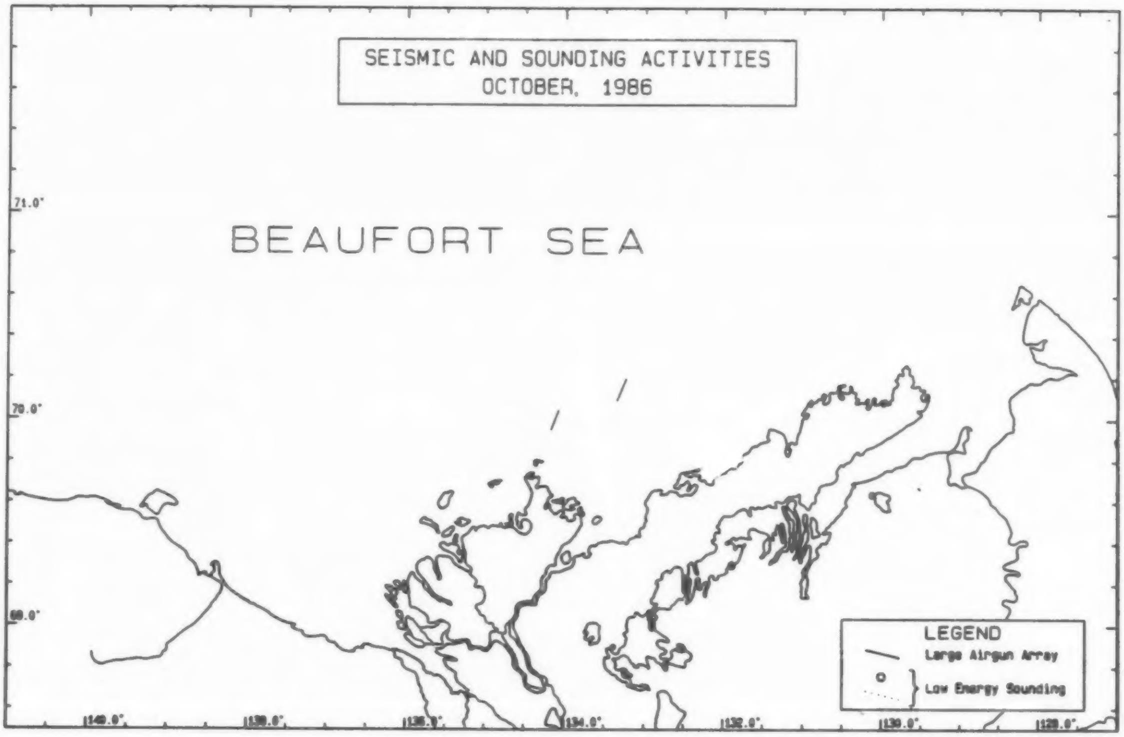
Map C-4: Seismic Activities, August 1986.


SEISMIC AND SOUNDING ACTIVITIES
SEPTEMBER, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Gas Guns
Low Energy Sounding

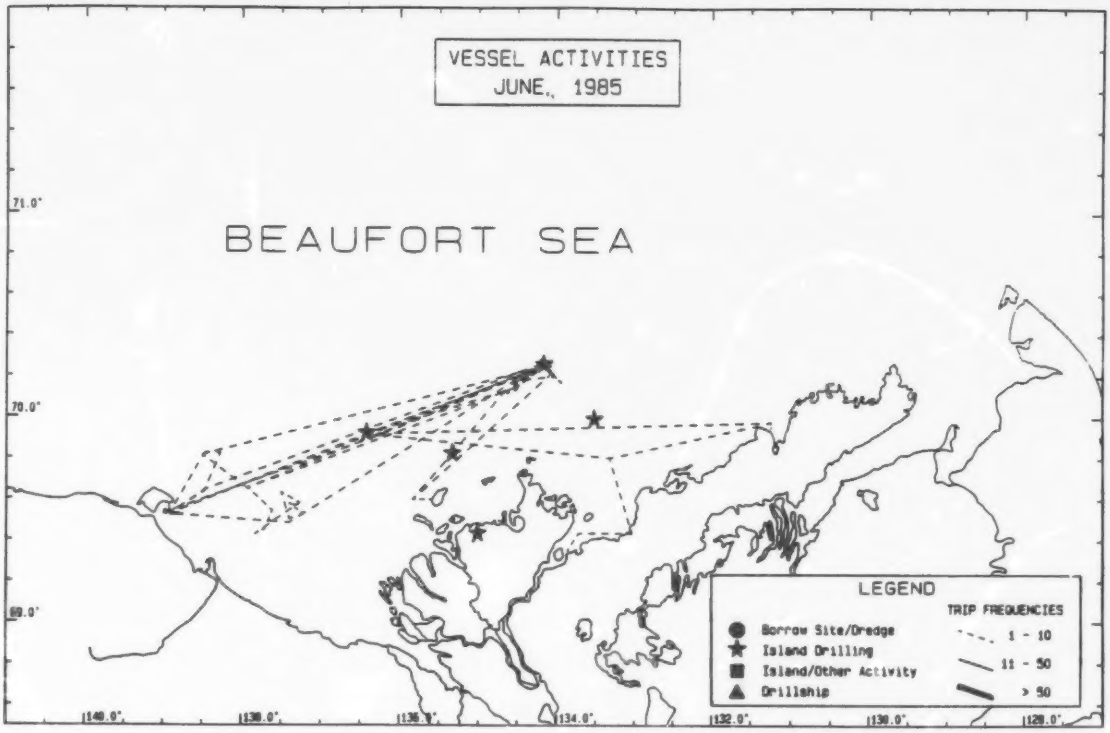
Map C-5: Seismic Activities, September 1985.


SEISMIC AND SOUNDING ACTIVITIES
SEPTEMBER, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Low Energy Sounding

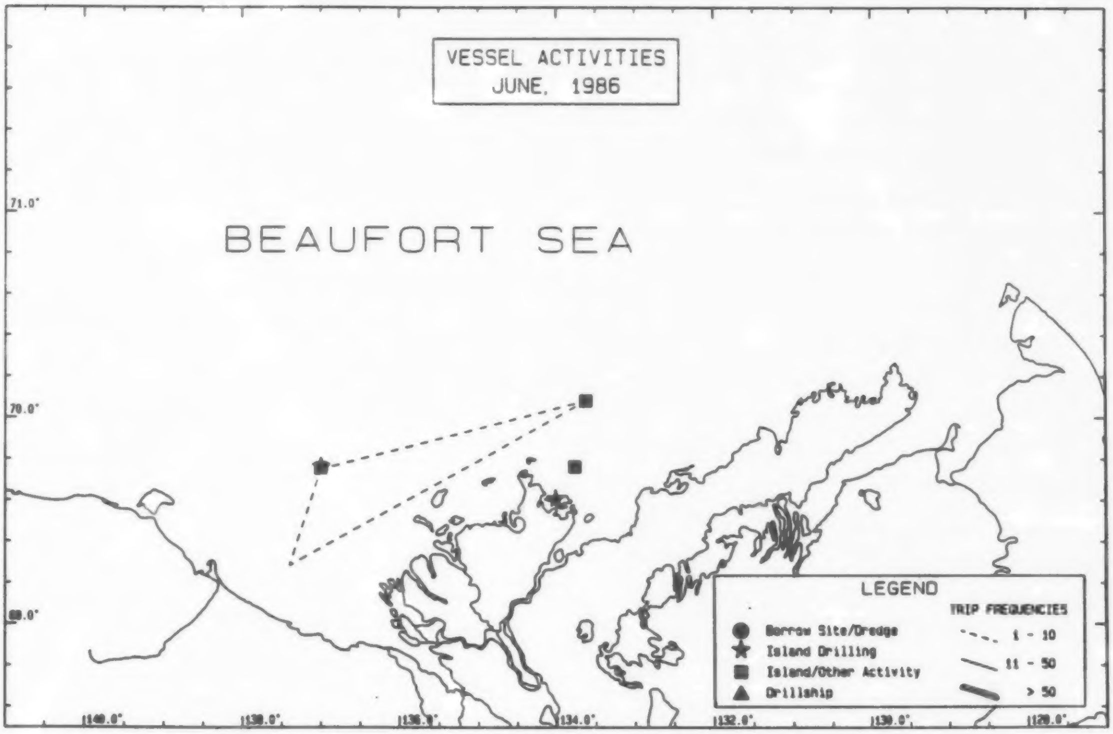
Map C-6: Seismic Activities, September 1986.


SEISMIC AND SOUNDING ACTIVITIES
OCTOBER, 1986
71.0°
70.0°
69.0°
BEAUFORT SEA
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Large Airgun Array
Low Energy Sounding

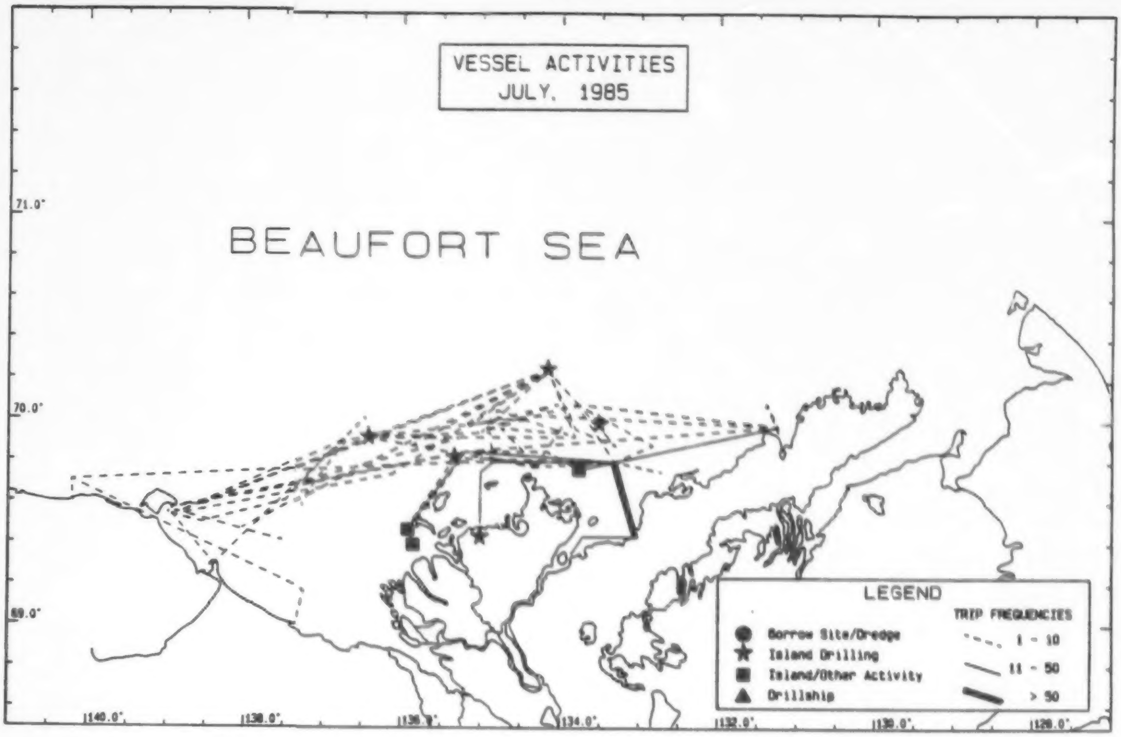
Map C-7: Seismic Activities, October 1986.


VESSEL ACTIVITIES
JUNE, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

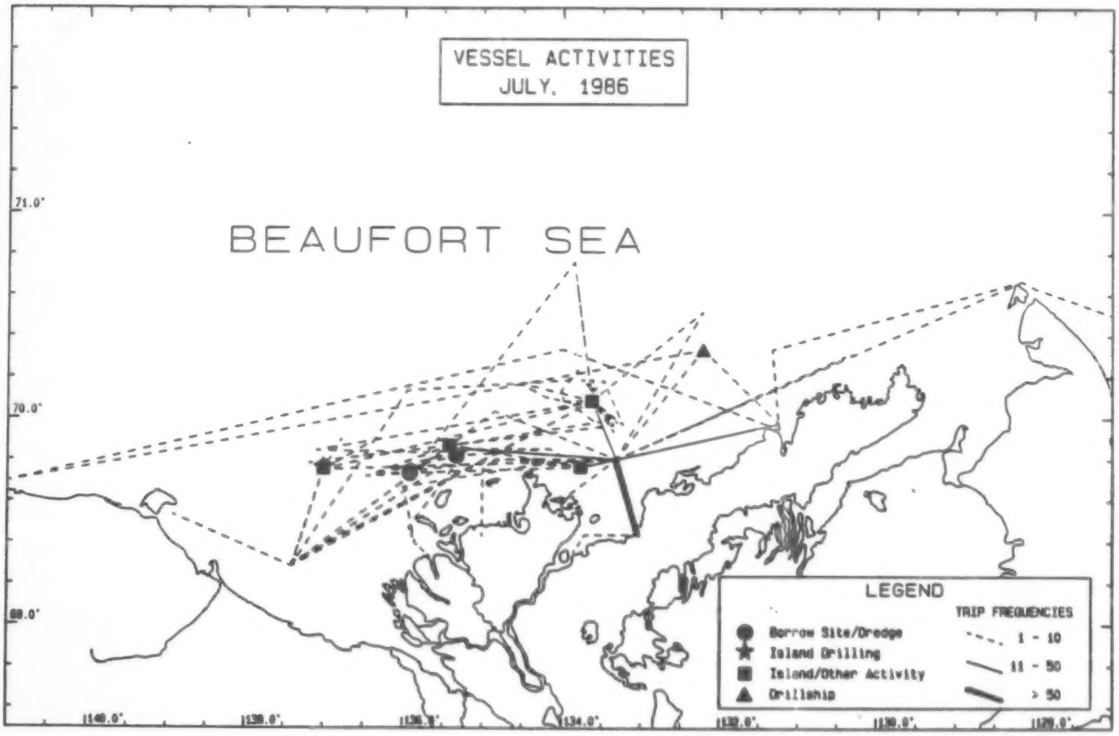
Map C-8: Vessel Activities, June 1985.


VESSEL ACTIVITIES
JUNE, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

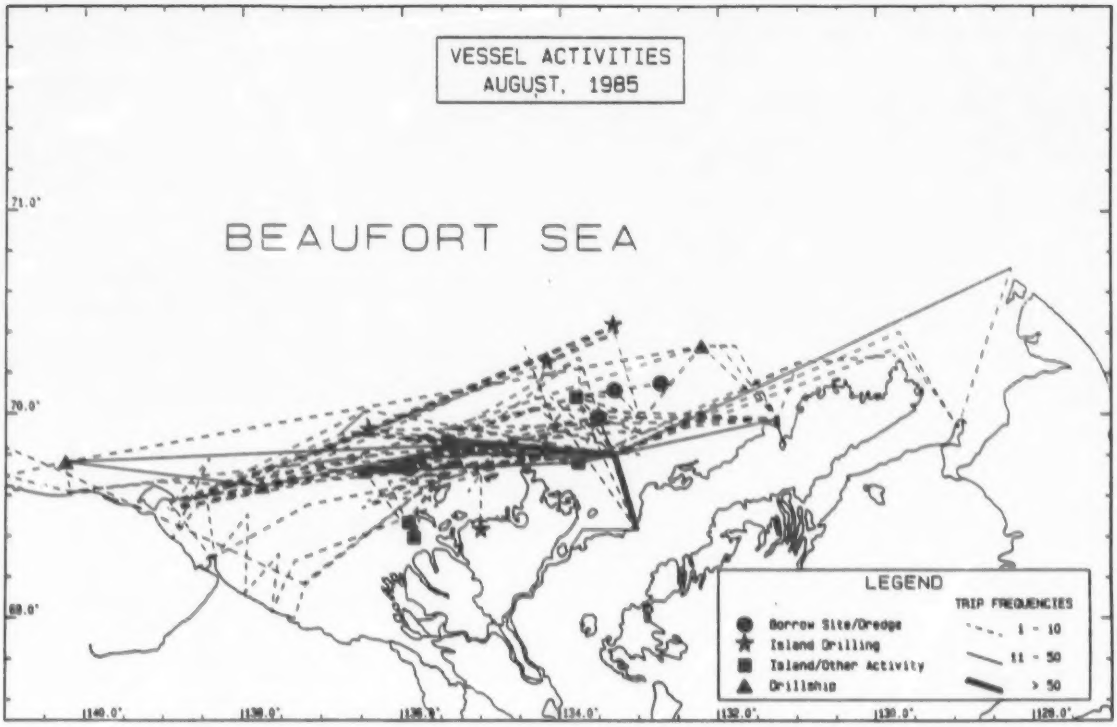
Map C-9: Vessel Activities, June 1986.


VESSEL ACTIVITIES
JULY, 1985
71.0°
BEAUFORT SEA
70.0°
69.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

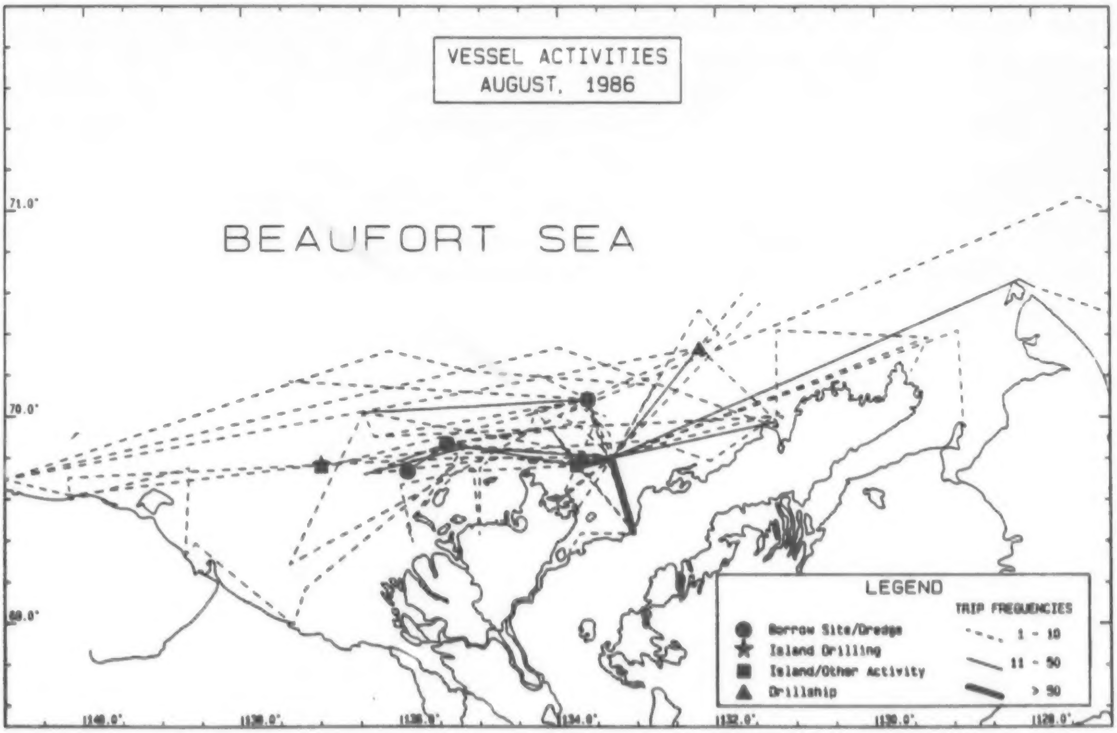
Map C-10: Vessel Activities, July 1985.


VESSEL ACTIVITIES
JULY, 1986
71.0°
BEAUFORT SEA
70.0°
69.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

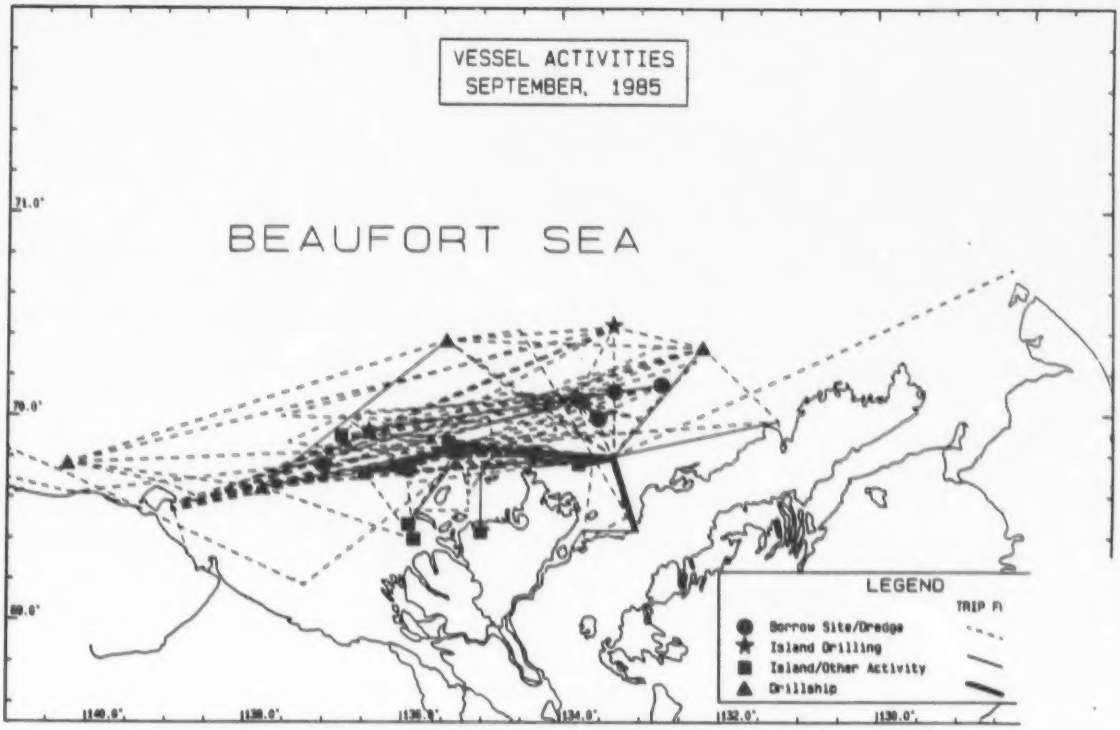
Map C-11: Vessel Activities, July 1986.


VESSEL ACTIVITIES
AUGUST, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

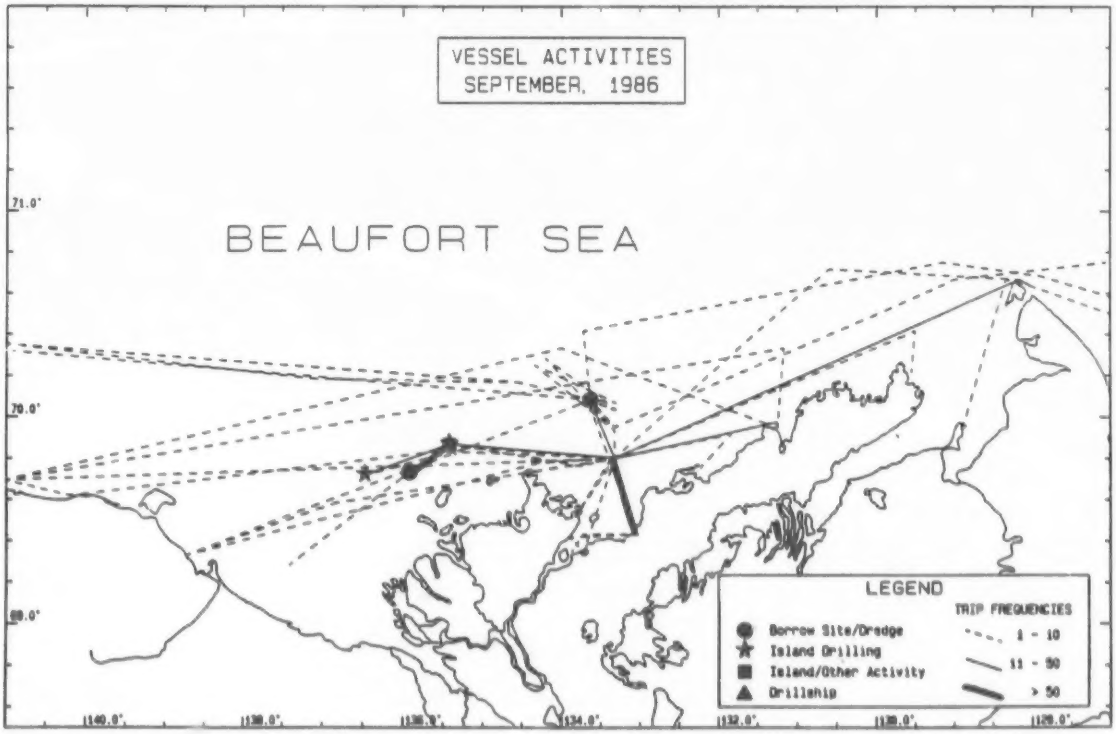
Map C-12: Vessel Activities, August 1985.


VESSEL ACTIVITIES
AUGUST, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

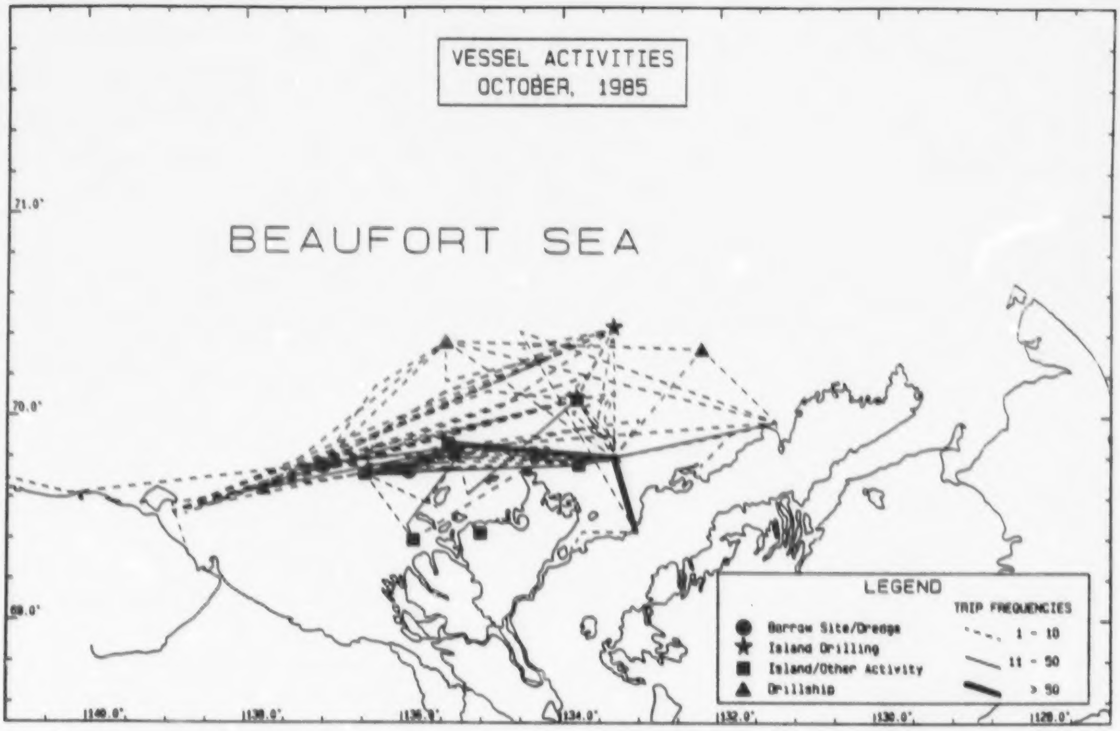
Map C-13: Vessel Activities, August 1986.


VESSEL ACTIVITIES
SEPTEMBER, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
LEGEND
TRIP F
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship

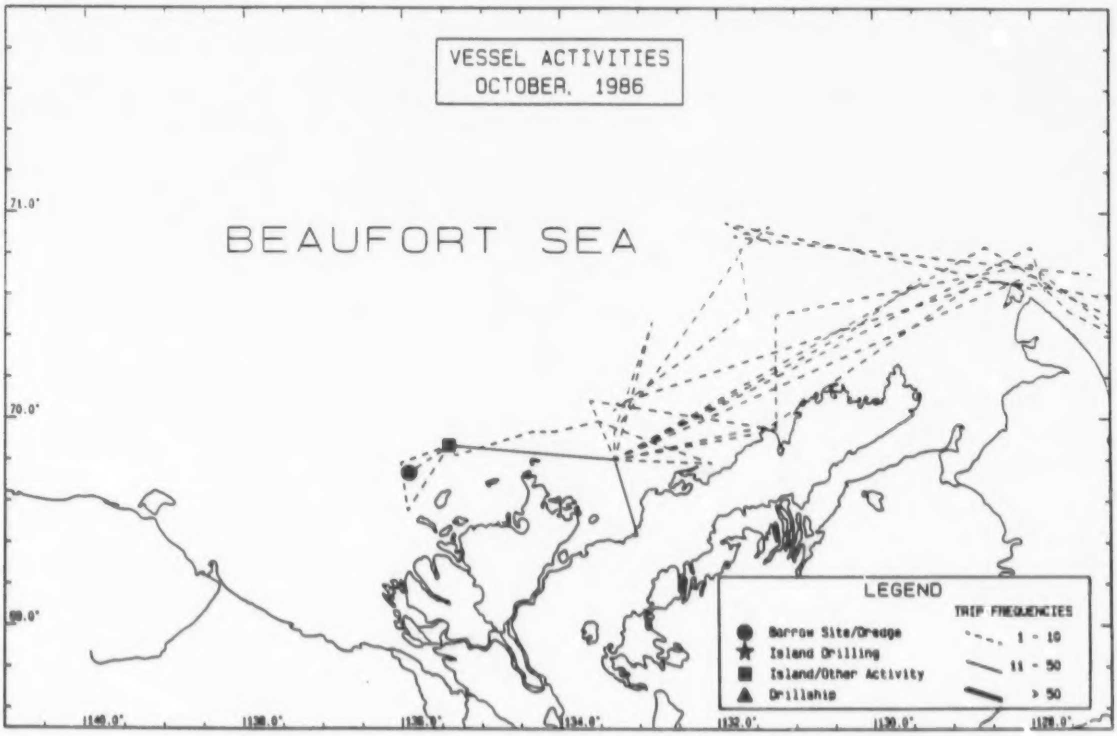
Map C-14: Vessel Activities, September 1985.


VESSEL ACTIVITIES
SEPTEMBER, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

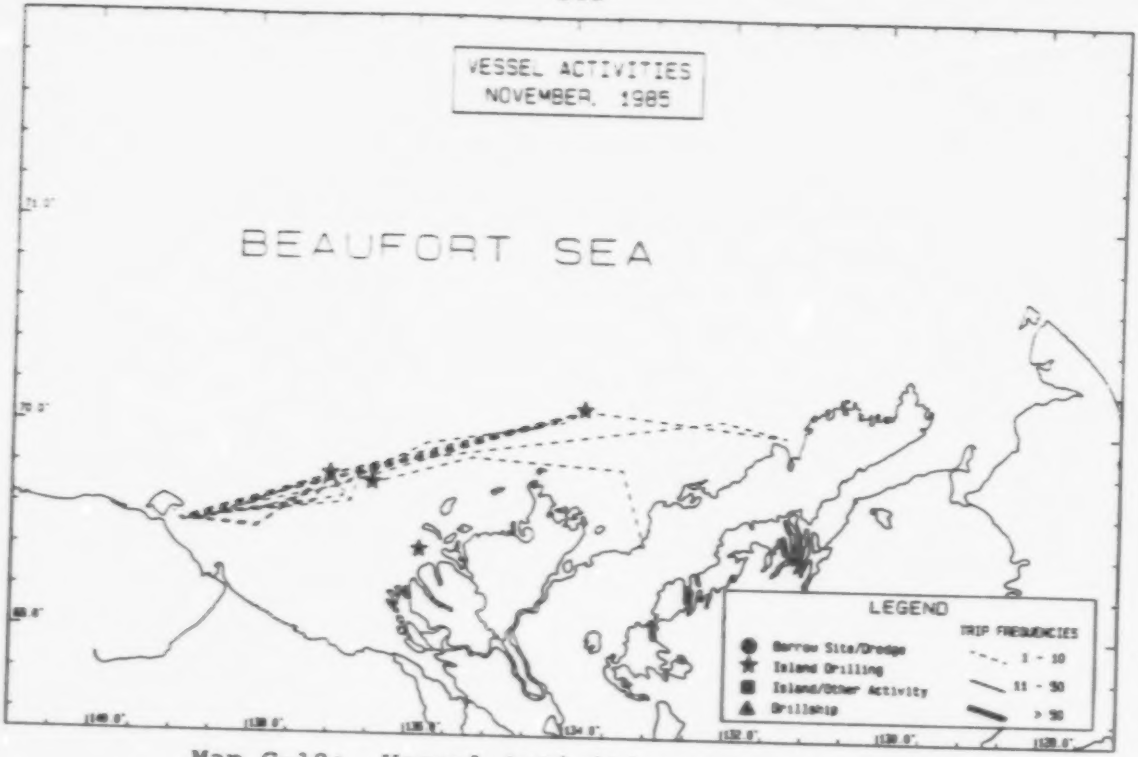
Map C-15: Vessel Activities, September 1986.


VESSEL ACTIVITIES
OCTOBER, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
● Barrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
TRIP FREQUENCIES
1 - 10
11 - 50
> 50

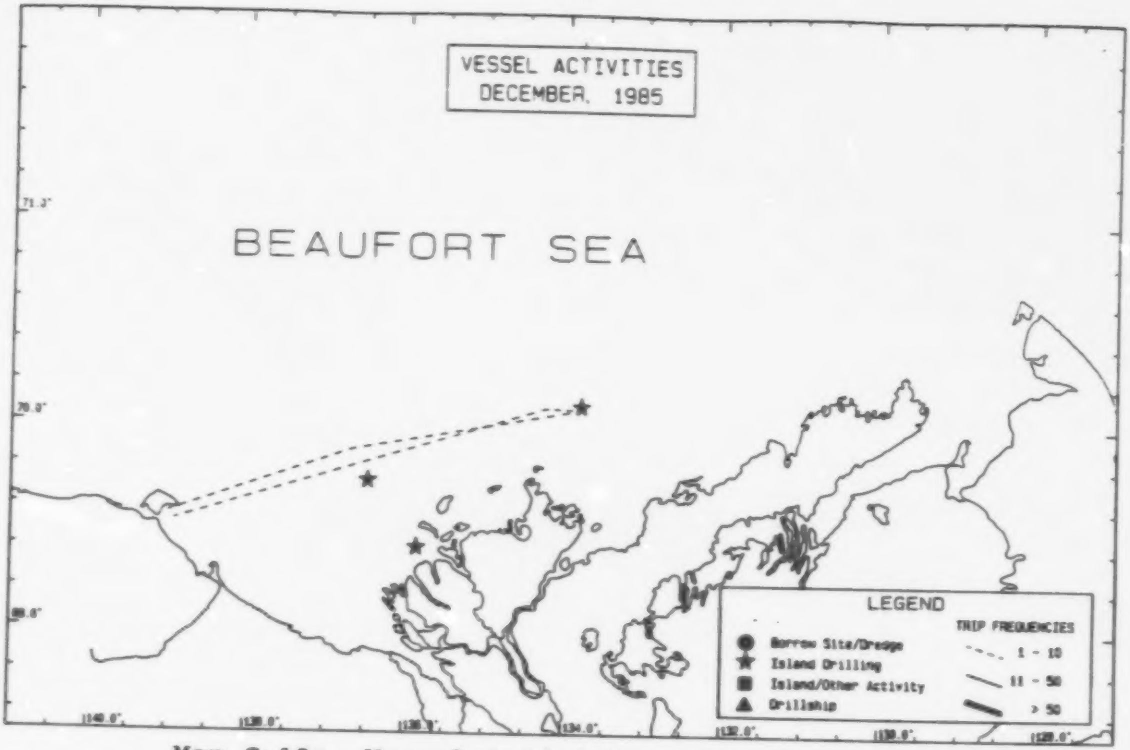
Map C-16: Vessel Activities, October 1985.


VESSEL ACTIVITIES
OCTOBER, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
● Barrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
TRIP FREQUENCIES
1 - 10
11 - 50
> 50

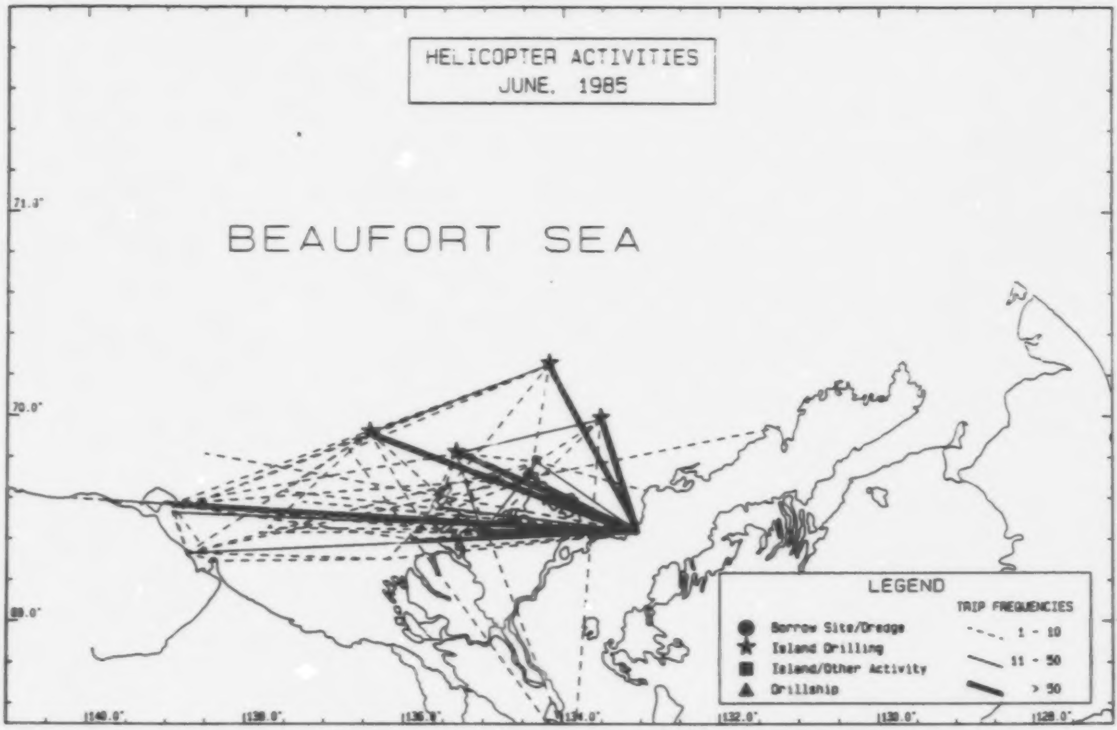
Map C-17: Vessel Activities, October 1986.


VESSEL ACTIVITIES
NOVEMBER, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
TRIP FREQUENCIES
1 - 10
11 - 50
> 50

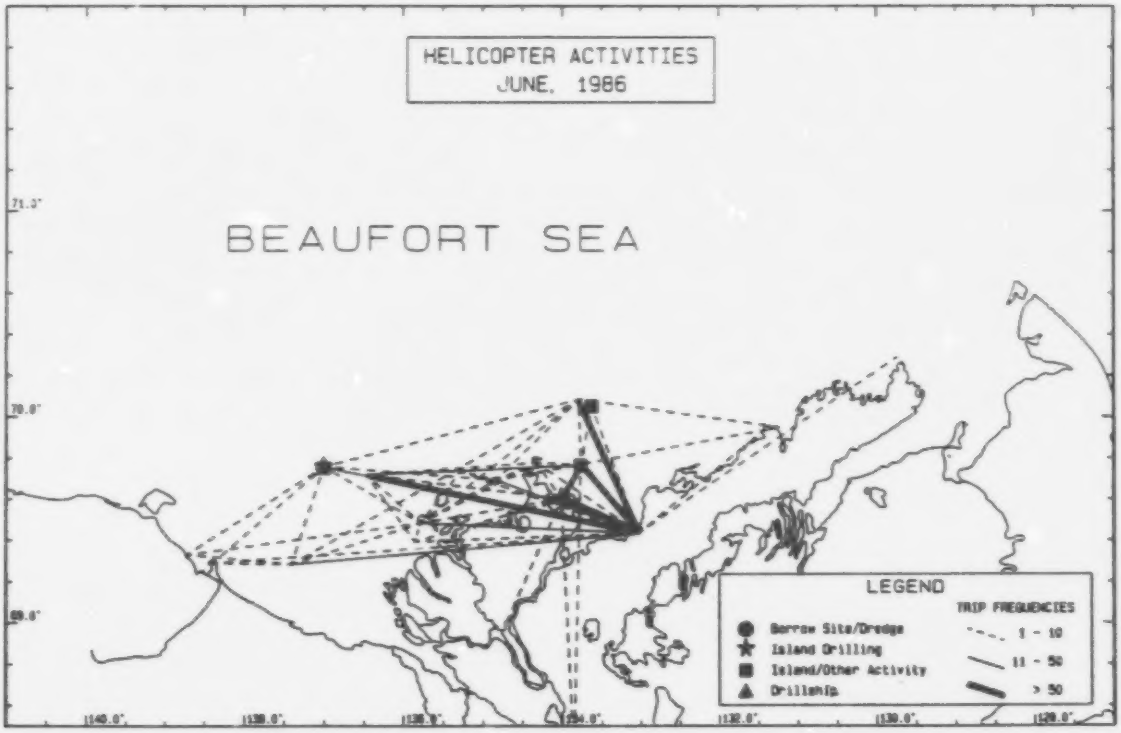
Map C-18: Vessel Activities, November 1985.


VESSEL ACTIVITIES
DECEMBER, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50

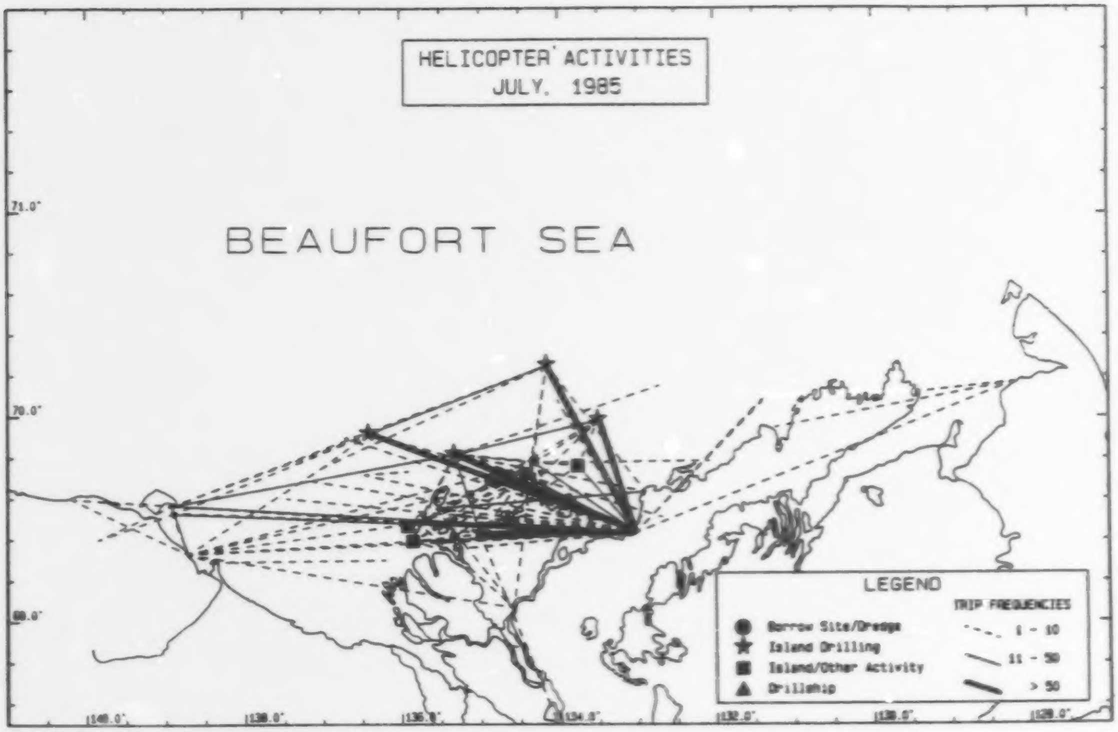
Map C-19: Vessel Activities, December 1985.


HELICOPTER ACTIVITIES
JUNE, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

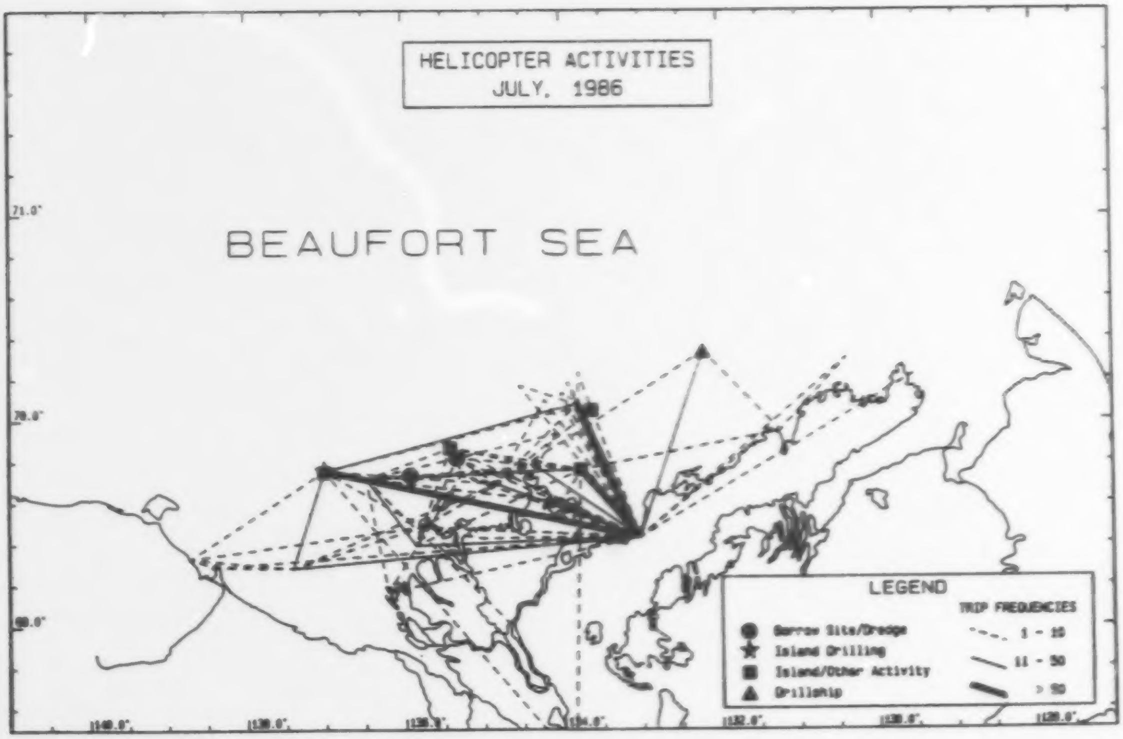
Map C-20: Helicopter Activities, June 1985.


HELICOPTER ACTIVITIES
JUNE, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

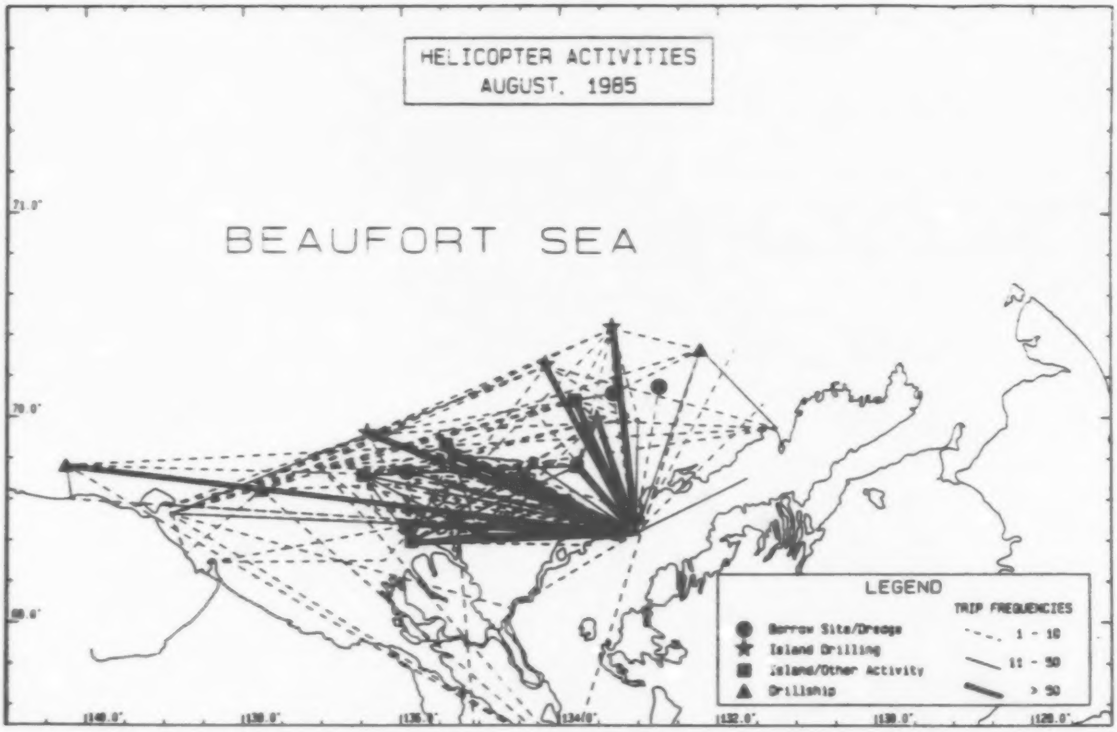
Map C-21: Helicopter Activities, June 1986.


HELICOPTER ACTIVITIES
JULY, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

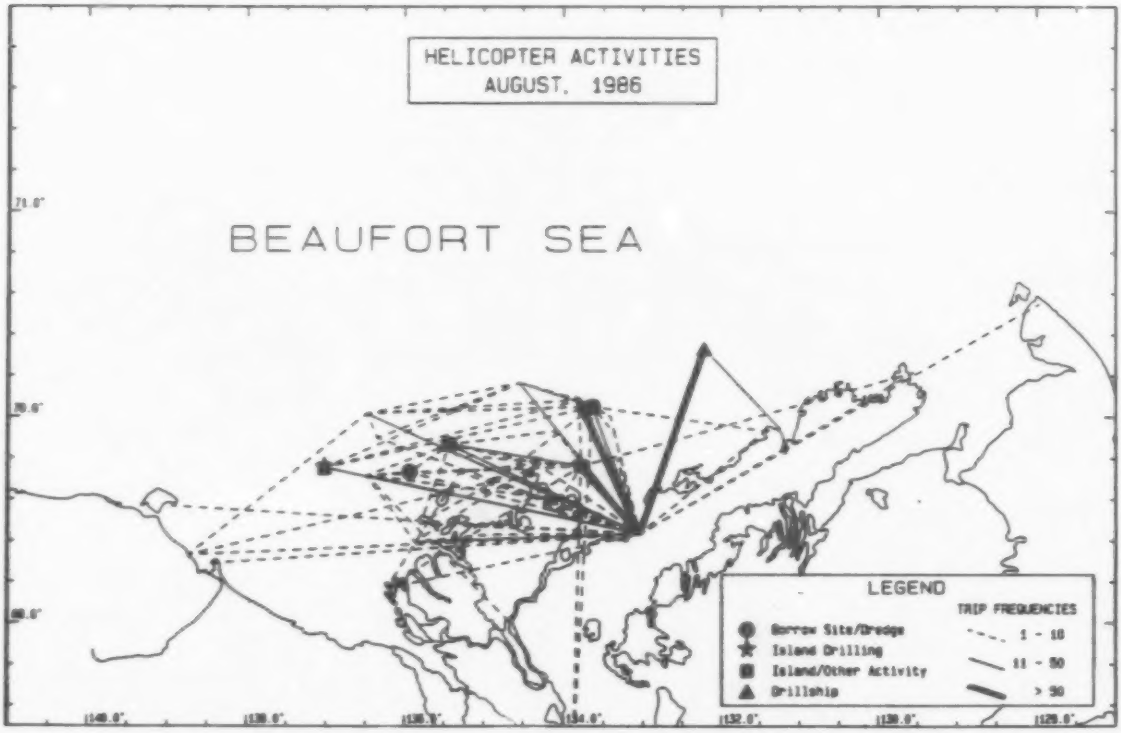
Map C-22: Helicopter Activities, July 1985.


HELICOPTER ACTIVITIES
JULY, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

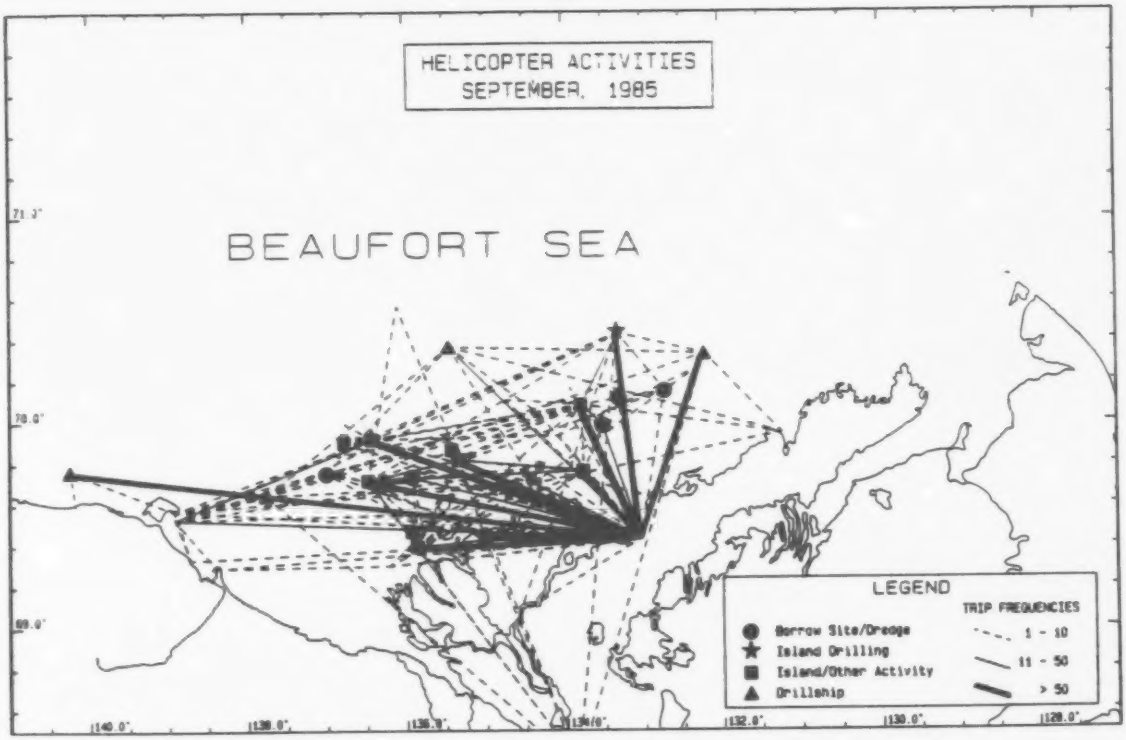
Map C-23: Helicopter Activities, July 1986.


HELICOPTER ACTIVITIES
AUGUST, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

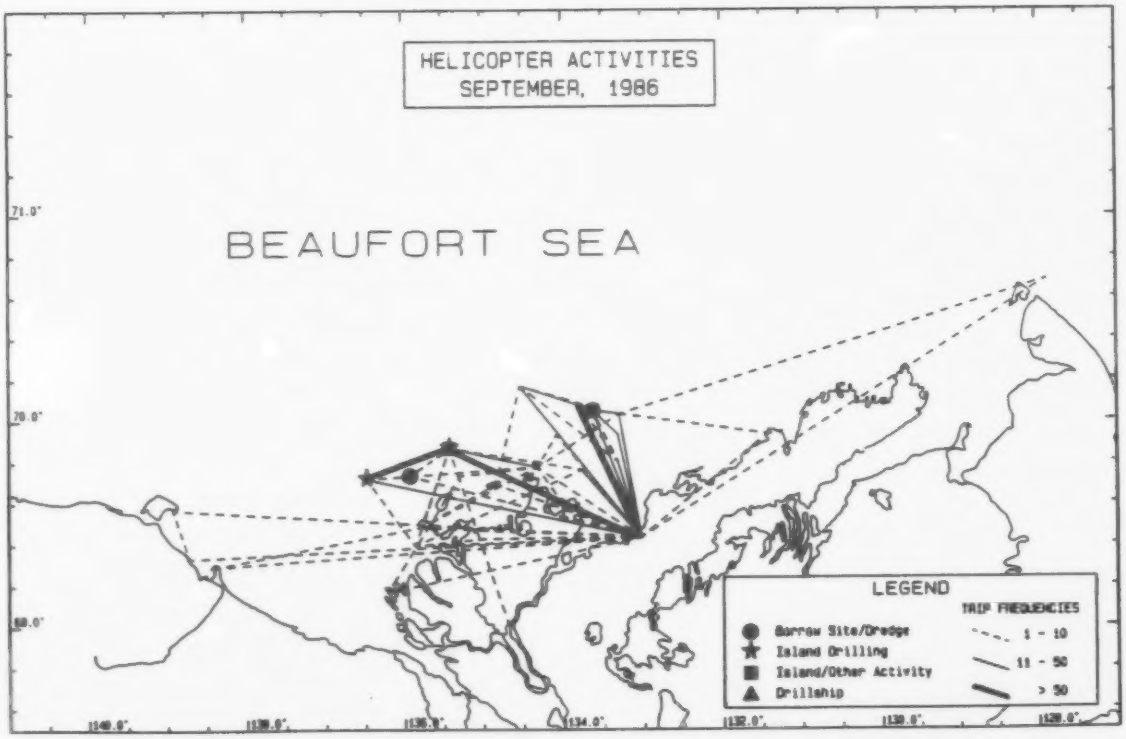
Map C-24: Helicopter Activities, August 1985.


HELICOPTER ACTIVITIES
AUGUST, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

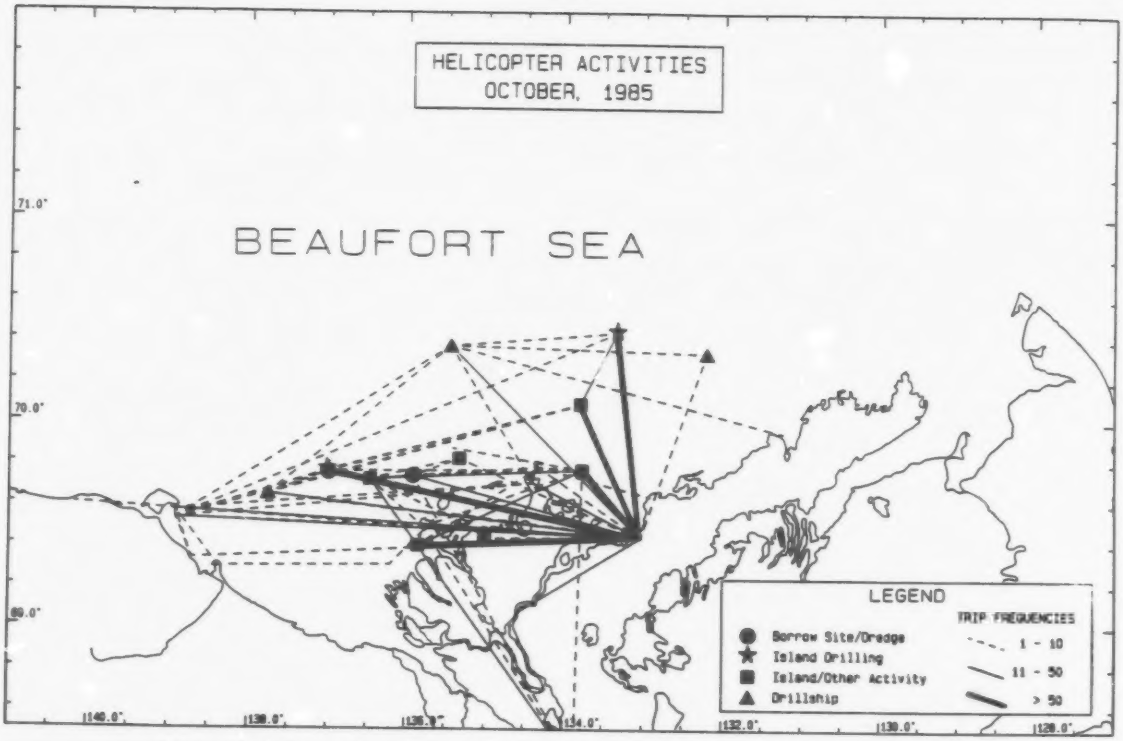
Map C-25: Helicopter Activities, August 1986.


HELICOPTER ACTIVITIES
SEPTEMBER, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

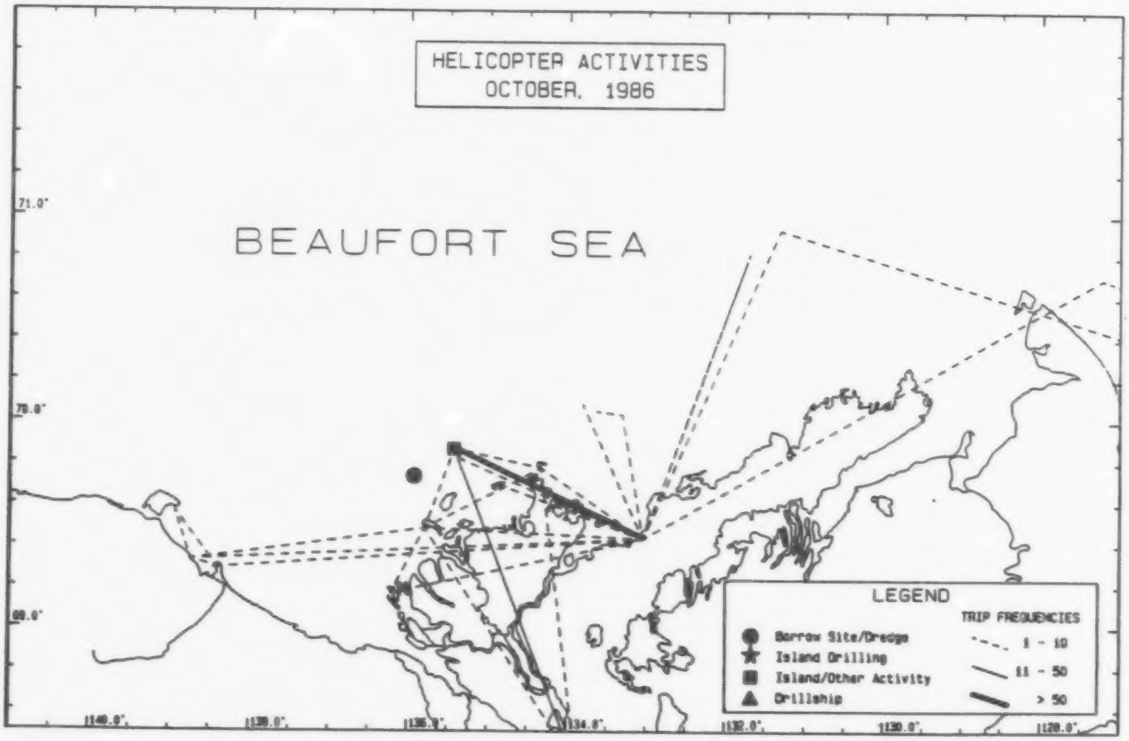
Map C-26: Helicopter Activities, September 1985.


HELICOPTER ACTIVITIES
SEPTEMBER, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

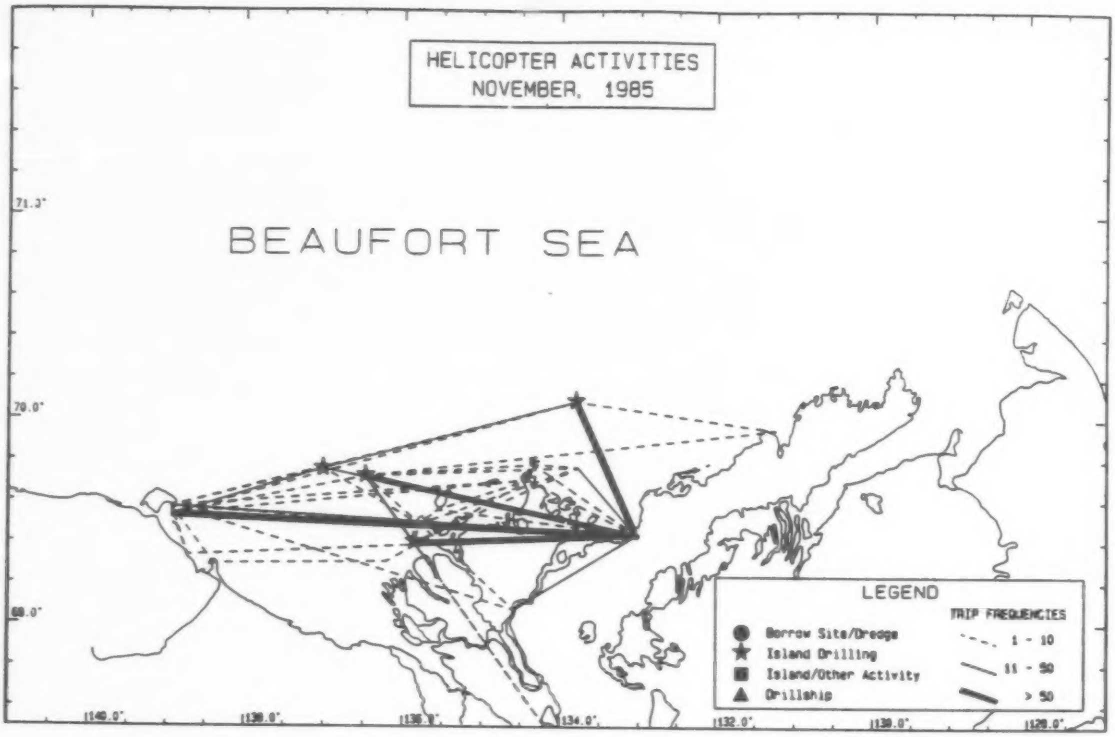
Map C-27: Helicopter Activities, September 1986.


HELICOPTER ACTIVITIES
OCTOBER, 1985
71.0°
70.0°
69.0°
BEAUFORT SEA
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

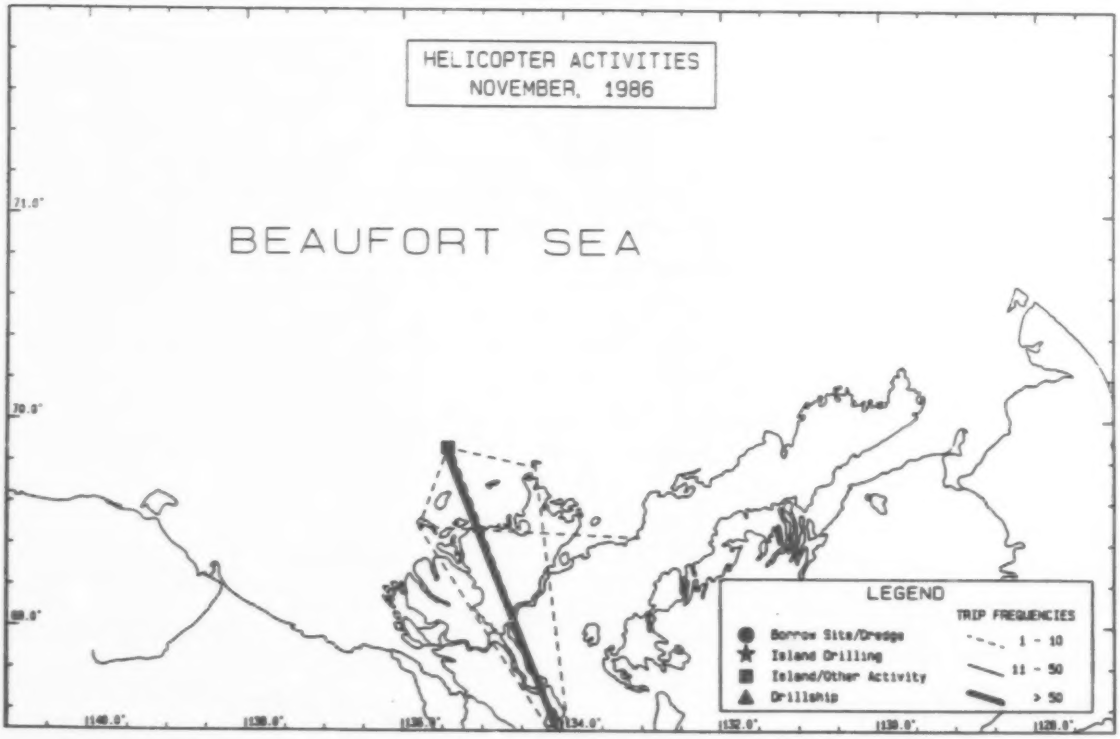
Map C-28: Helicopter Activities, October 1985.


HELICOPTER ACTIVITIES
OCTOBER, 1986
71.0°
70.0°
69.0°
BEAUFORT SEA
LEGEND
TRIP FREQUENCIES
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
1 - 10
11 - 50
> 50
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°

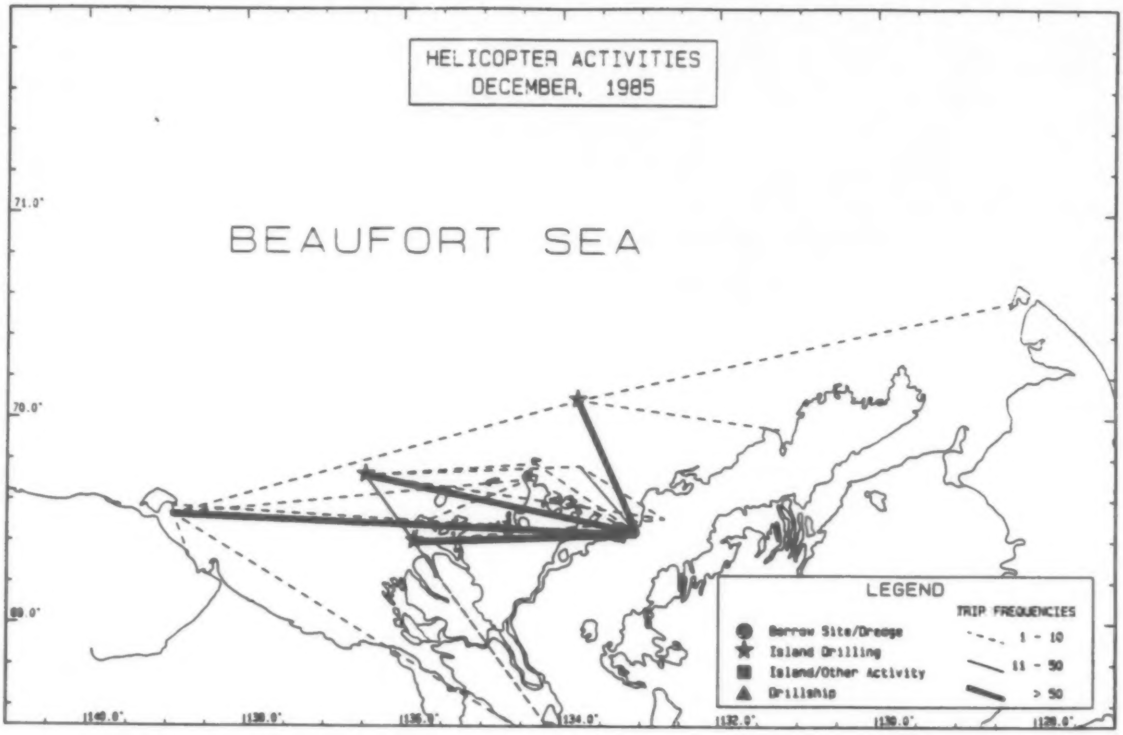
Map C-29: Helicopter Activities, October 1986.


HELICOPTER ACTIVITIES
NOVEMBER, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
TRIP FREQUENCIES
1 - 10
11 - 50
> 50

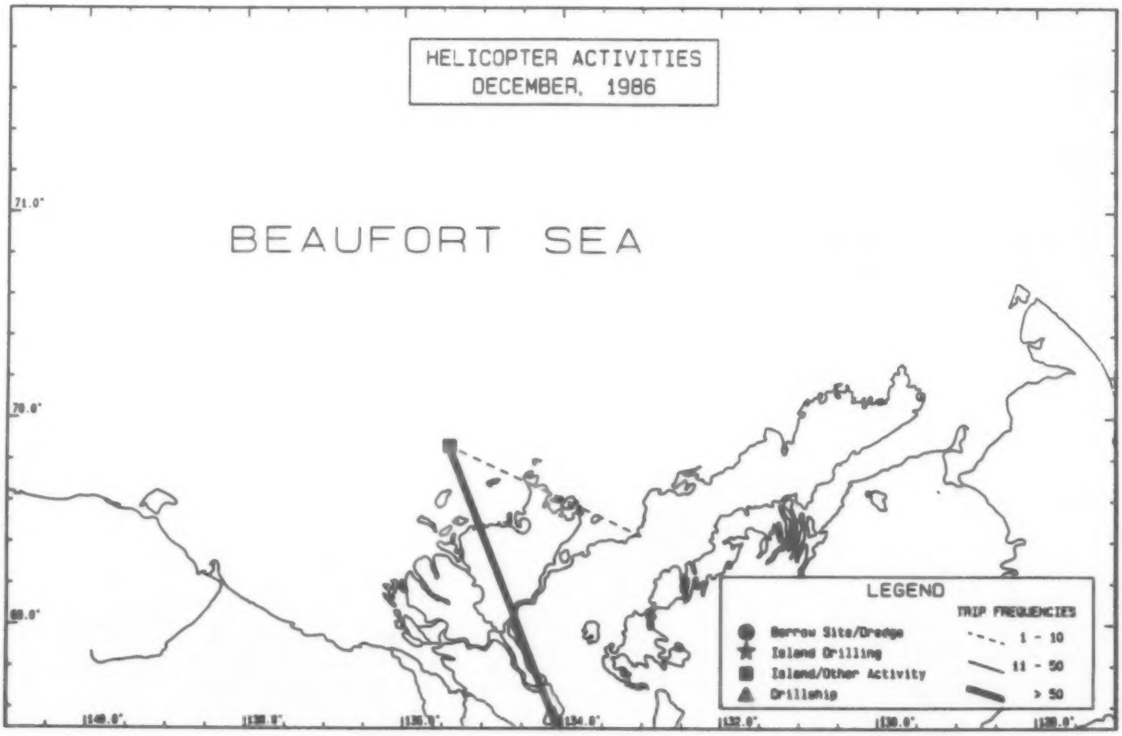
Map C-30: Helicopter Activities, November 1985.


HELICOPTER ACTIVITIES
NOVEMBER, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
Borrow Site/Dredge
Island Drilling
Island/Other Activity
Drillship
TRIP FREQUENCIES
1 - 10
11 - 50
> 50

Map C-31: Helicopter Activities, November 1986.


HELICOPTER ACTIVITIES
DECEMBER, 1985
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

Map C-32: Helicopter Activities, December 1985.


HELICOPTER ACTIVITIES
DECEMBER, 1986
BEAUFORT SEA
71.0°
70.0°
69.0°
140.0°
138.0°
136.0°
134.0°
132.0°
130.0°
128.0°
LEGEND
TRIP FREQUENCIES
● Borrow Site/Dredge
★ Island Drilling
■ Island/Other Activity
▲ Drillship
1 - 10
11 - 50
> 50

Map C-33: Helicopter Activities, December 1986.